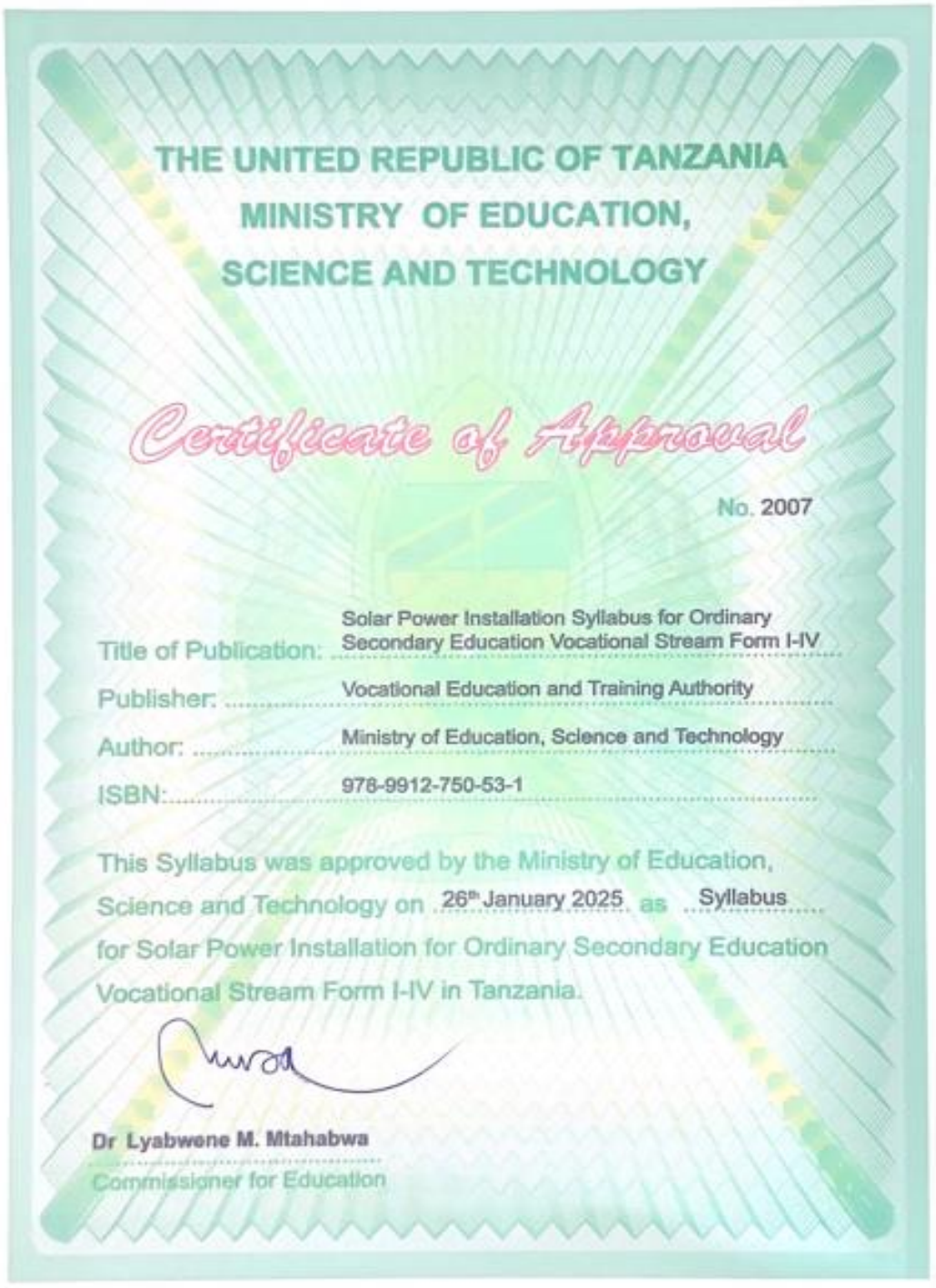
# THE UNITED REPUBLIC OF TANZANIA

## MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY



THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION,
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Dr Lyabwene M. Mtahabwa
Commissioner for Education

**SOLAR POWER INSTALLATION SYLLABUS FOR ORDINARY SECONDARY EDUCATION VOCATIONAL STREAM FORM I-IV**

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## Abbreviations and Acronyms

| | |
|---|---|
| DOL | Direct On-Line |
| HIM | Human Interface Machine |
| PLC | Programmable Logic Control |
| PSU | Power Supply Unit |
| SCADA | Supervisory Control and Data Acquisition |
| SOW | Scope of Work |
| TNA | Training Need Assessment |

**Definition of Key Terms**

**Assessment:** The process of collecting evidence and making judgments on whether competency has been achieved, or whether specific skills and knowledge have been achieved that will lead to the attainment of competency.

**Circumstantial knowledge:** Detailed knowledge, which allows the decision-making in regard to different circumstances and cross cutting issues.

**Competence:** The ability to use knowledge, understanding, practical and thinking skills to perform effectively to the workplace standards required in employment.

**Element:** A sub- unit (step) which reflects learning sequence with the aim of achieving broad learning objectives of a unit.

**Performance criteria**: An indication of the expected end results or outcome in form of evaluative statements.

**Standard**: A set of statements, which if proved true under working conditions, means that an individual is meeting an expected level and type of performance.

**Unit**: A statement of broad learning objectives, which prescribe the requirements of a standard in form of practical skills, knowledge and appropriate attitudes.

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For and on behalf of:

**Vocational Education and Training Authority**

CPA. Anthony M. Kasore

**Director General**

## Introduction

Solar Power Installation is one of the occupations taught in the Ordinary Secondary Education Vocational Stream. Learning Solar Power Installation is essential because Tanzania is a tropical country with at least ten months of sunshine in a year. This source is clean and renewable hence leveraging it can support the country's economy.

Developing such knowledge, skills and attitude will enable a graduate to create self-employment, be employed in both Government and private sectors such as ministries/departments, training institutions, research institutions, energy sector, projects, energy industries and Non-Governmental Organizations (NGOs) as well asemploy others.

The Solar Power Installation Syllabus is designed to guide the teaching and learning of Solar Power Installation at Ordinary Secondary Education Form I-IV Vocational Stream in the United Republic of Tanzania. The syllabus interprets the competences a student needs to develop while learning Solar Power Installation. It contains valuable information that will enable teachers to effectively plan their teaching process and help learners to develop the intended competences.

## Main Objectives of Education in Tanzania

The main objectives of education in Tanzania are to enable every Tanzanian to:

(a) Develop and improve his or her personality so that he or she values himself or herself and develops self-confidence;

(b) Respect the culture, traditions, norms and customs of Tanzania; cultural differences; dignity; human rights; attitudes and inclusive actions;

(c) Advance knowledge and apply science and technology, creativity, critical thinking, innovation, cooperation, communication and positive attitudes for his or her development and the sustainable development of the nation and the world at large;

(d) Understand and protect national values, including dignity, patriotism, integrity, unity, transparency, honesty, accountability and the national language;

(e) develop life and work-related skills to increase efficiency in everyday life;

(f) Develop a habit of loving and valuing work to increase productivity and efficiency in

production and service provision;

(g) Identify and consider cross-cutting issues, including the health and well-being of the society, gender equality, as well as the management and sustainable conservation of the environment; and

(h) Develop national and international cooperation, peace and justice per the Constitution of the United Republic of Tanzania and international conventions.

**General Competences for Ordinary Secondary Education Vocational Stream**

The general competences for Ordinary Secondary Education, Form 1–IV, Vocational Education stream is to:

(a) Apply the knowledge, skills and attitudes the students developed in the primary school stage to increase his/her understanding of technical skills;

(b) Apply technical skills in designing, inventing and making various things to cope with life and solve challenges in society;

(c) Appreciate citizenship and national virtues;

(d) Use language skills;

(e) Demonstrate self-confidence in learning in various fields, including science and technology, technical knowledge and technical skills;

(f) Apply technical knowledge and skills in designing, discovering and making various things to solve challenges in society, including cross-cutting issues;

(g) Appreciate procedures and safety rules in using technical tools correctly; and

(h) Apply the technical knowledge and skills acquired to develop oneself with vocational and technical education and join the workforce.

**General Competences of the Occupation**

Upon completion of this occupation, students are expected to have the ability to:

(a) Perform Solar systems installation;
(b) Perform maintenance of solar systems
(c) Maintain safety and health awareness;

**Main and Specific Competences**

The main and specific competences to be developed are presented in Table 1

**Table 1:** *Main and Specific Competences for Form I-IV*

| Modules (Main Competence) | Units (Specific competences) |
|---|---|
| 1.0 Maintaining health, safety and environment at the Workplace | 1.1 Handling workshop safety<br>1.2 Handling workshop tools<br>1.3 Handling workshop equipment<br>1.4 Carrying-out health and safety investigations<br>1.5 handling fire accidents<br>1.6 Performing first aid<br>1.7 Maintaining buildings<br>1.8 Maintaining a safe working environment |
| 2.0 Performing preventive maintenance of tools, equipment and machines. | 2.1 Performing preventive maintenance of electrical tools<br>2.2 Performing preventive maintenance of basic electrical equipment<br>2.3 Performing preventive maintenance of simple electric machines |
| 3.0 Performing bench works | 3.1 Performing machining operations<br>3.2 Performing forming operation<br>3.3 Performing surface finishing operation<br>3.4 Performing bearing removal and mounting<br>3.5 Perform threading. |
| 4.0 Selecting solar PV system components | 4.1 Specifying solar PV system major components<br>4.2 Performing solar PV basic measurement |
| 5.0 Performing electrical joints | 5.1 Performing Cold Electrical Joints.<br>5.2 Performing soldering |
| 6.0 Building simple dc circuits | 6.1 Constructing resistive circuits<br>6.2 construct capacitive circuits<br>6.3 Constructing inductive circuits<br>6.4 Constructing RLC circuit<br>6.5 Measuring electric quantities<br>6.6 Determining characteristics of active electronic components<br>6.7 Constructing rectifier circuits |
| 7.0 Performing basic electrical installation | 7.1 Installing lighting circuits<br>7.2 installing power circuits |

| Modules (Main Competence) | Units (Specific competences) |
|---|---|
| | 7.3 Installing alarm and signal circuits<br>7.4 Installing Basic Protective Device<br>7.5 Carrying Out Earthing Systems<br>7.6 Carrying Out Electrical Tests |
| 8.0 Installing cables and cable enclosures | 8.1 Installing cables<br>8.2 Erecting conduits<br>8.3 Erecting trunking and cable trays<br>8.4 Constructing ducts and trenches |
| 9.0 Installing switch gear and protective device | 9.1 Installing switch gear<br>9.2 Installing Protective Devices<br>9.3 Installing fire detection and alarm system |
| 10.0 Installing solar PV systems | 10.1 Handling solar PV array<br>10.2 Install solar electric system components<br>10.3 Designing PV solar power system<br>10.4 Constructing solar PV mounting structure |
| 11.0 InstallingSolar Thermal Systemss | 11.1 Installing water solar heater<br>11.2 Installing solar water pump |
| 12.0 Constructing solar PV powermini-grid | 12.1 Constructing electrical distribution lines<br>12.2 Installing distribution transformer<br>12.3 Installing electrical service |
| 13.0 Performing maintenance of electrical systems | 13.1 Carrying out preventive maintenance<br>13.2 Carrying out corrective maintenance |
| 14.0 Installing electrical machines | 14.1 Installing AC machines<br>14.2 Installing control of single-phase AC motors<br>14.3 Installing control of three-phase AC motors<br>14.4 Installing DC machines<br>14.5 Installing control of DC machines<br>14.6 Installing electronic soft starter<br>14.7 Installing variable frequency drive |
| 15.0 Installing electronic control and monitoring systems | 15.1 Installing PLC components<br>15.2 Performing PLC programming<br>15.3 Installing PLC networking and communication system |
| 16.0 Installing hybrid systems | 16.1 Installing inverter chargers<br>16.2 Installing change-over switch<br>16.3 Installing hybrid solar PV system |
| 17.0 FabricatingSolar Thermal Systemss | 17.1 developing solar heater<br>17.2 Developing solar parabolic concentrator<br>17.3 Developing solar dryers |
| 18.0 Maintaining and managing solar PV systems | 18.1 Performing routine maintenance<br>18.2 Performing system corrective maintenance |
| 19.0 Managing resources | 19.1 Establishing tools, equipment and |

| Modules (Main Competence) | Units (Specific competences) |
|---|---|
| | materials profile.<br>19.2 Estimating materials and labour costs<br>19.3 Preparing a small-scale tender document<br>19.4 Training subordinates<br>19.5 Supervising subordinates |
| 20.0 Managing safe work environment | 20.1 Managing hazards<br>20.2 Carrying out risk assessment<br>20.3 Managing environment |

**The Roles of Teachers, Students and Parents/Guardians in Teaching and Learning**

A good relationship between a teacher, student's parent, or guardian is fundamental to ensuring successful learning. This section outlines the roles of each participant in facilitating effective teaching and learning of Solar Power Installation.

## 6.1 The teacher

The teacher is expected to:

(a) Help the students to learn and develop the intended competences in Solar Power Installation

(b) Use teaching and learning approaches that will allow students with different needs and abilities to:

(i) Develop the competences needed in the 21st Century; and

(ii) Actively participate in the teaching and learning process.

(c) Use student's instructional strategies that make the students a centre of learning which allow them to think, reflect and search for information from various sources;

(d) Create a friendly teaching and learning environment;

(e) Prepare and improvise teaching and learning resources;

(f) Conduct formative assessment regularly by using tools and methods which assess theory and practice;

(g) Treat all the students according to their learning needs and abilities;

(h) Protect the students from the risky environment while he or she is at school;

(i) Keep track of the students's daily progress;

(j) Identify individual students's needs and provide the proper intervention;

(k) Involve parents/guardians and the society at large in the student's learning process; and

(l) Integrate cross-cutting issues and ICT in the teaching and learning process.

### 6.2 The students

The students is expected to:

(a) Develop the intended competences by participating actively in various learning activities inside and outside the classroom; and

(b) Participate in the search for knowledge from various sources, including textbooks, reference books and other publications in online libraries.

### 6.3 The parent/guardian

The Parents/Guardian is expected to:

(a) Monitor the child's academic progress
(b) Where possible, provide a child with the needed academic support;
(c) Provide a child with a safe and friendly home environment which is conducive to learning;
(d) Keep track of a child's progress in behaviour;
(e) Provide the child with any necessary materials required in the learning process; and
(f) Instill in a child a sense of commitment and positive value towards education and work.

### Teaching and Learning Methods

The teaching and learning methods are instrumental in developing students's competences. This Syllabus suggests teaching and learning methods for each activity which includes but is not limited to practical/hands-on activities, observations, role play, simulation, group works, peer teaching/learning, discussions, presentations, field visits, research, and project works. However, a teacher is advised to plan and use other appropriate methods based on the environment or context. All the teaching and learning methods should be integrated with the everyday lives of students. The focus is expected to be on practical application and developing cognitive, affective, and psychomotor skills through learner-centred methods. Vocational teachers act as facilitators, incorporating both school-based teaching and project work supervision.

### Teaching and Learning Resources

The process of teaching and learning requires different resources. In that regard, both a teacher and students should work together to collect or improvise alternative resources

available in the school and home environment when needed. Teachers and students are expected to constantly seek information from various sources to effectively facilitate the teaching and learning process. The list of approved textbooks and reference books shall be provided by the TIE.

**Assessment**

Assessment is important in teaching and learning of Solar Power Installation occupation. It is divided into formative and summative assessments. Formative assessment informs both the teacher and students on the progress of teaching and learning, and in making decisions on improving the teaching and learning process. Teachers are, therefore, expected to apply a wide range of formative assessment methods which include but are not limited to, discussions, presentations, oral questions, experiments, observations, practical assignments and projects.

Summative assessment, on the other hand, will focus on determining students's achievement of learning. Teachers are expected to use a variety of summative assessments including Form Two National Assessment, terminal examination, annual examination, mock examination and project. The scores obtained from these assessments will be used as Continuous Assessment (CA). Therefore, the continuous assessments shall contribute 60% and the National Form IV Examination shall be 40% as indicated in Table 2.

## 9.1 Project work

*Project work is a carefully planned and clearly defined task or problem that a student undertakes, either alone or in a group, to enhance and apply the skills and knowledge gained in the classroom, workshop, kitchen, or laboratory. It is based on the principles of "Learning by Doing" and "Learning by Living." In this context, the implementation of Project Work in secondary schools' vocational streams is essential. Projects in the vocational stream should be conducted in the core subject (occupation). To ensure its success, the supervision and assessment of student's project work must be consistent with the established guidelines provided by the National Examinations Council of Tanzania (NECTA).*

**Table 2:** *Contribution of Continuous Assessment and National Examination in the final score*

| **Assessment Category** | **Weight (%)** | **National Examination** |
|---|---|---|
| Form Two National Assessment (FTNA) | 6.0 | **40** |
| Form Three Terminal Examination | 5.0 | |
| Form Three Anual Examination | 5.0 | |
| Form Four Mock Examination | 7.0 | |
| Project | 7.0 | |
| Form Two Practical | 10.0 | |
| Form Three Practical | 10.0 | |
| Form Four Practical | 10.0 | |
| **Total** | **60** | |

**Number of Periods**

The Solar Power Installation Syllabus for Ordinary Secondary Education Vocational Stream Form I-IV provides time estimates for teaching and learning each specific competence. The estimates consider the complexity of the specific competences and the learning activities. Eight (08) periods of 40 minutes each have been allocated per week, whereby two (02) periods will be used for theory and 6 for practical sessions which may require double periods (e.g., 80). Double periods will allow sufficient time for hands-on activities.

**Teaching and Learning Contents**

The contents of the Syllabus are organised into a matrix with seven (07) columns which are main competences, specific competences, learning activities, suggested teaching and learning methods, assessment criteria which are divided into (process assessment, products/service assessment and knowledge assessment), suggested teaching and learning resources and number of periods as presented in Table 3 to 6.

# Form One

**Table 3:** *Detailed contents for Form One*

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| 1.0 Maintaining health, safety and environment at the workplace | 1.1 Handling workshop safety | (a) Maintaining workshop safety rules | **Question and answer**<br>Engage students by asking questions about workshop safety rules and then discussing the answers.<br>**ICT –based learning**<br>Guide students to search workshop safety rules on the internet and present the findings<br>**Observation**<br>Let students visit the workshop under your supervision to observe, discuss the observations with them, and demonstrate proper safety procedures and practices in the | The students should explain:<br>• The importance of following safety rules in the workshop.<br>• Procedures for maintaining a clean and safe workshop environment | Safety of the workshop is maintained as per safety rules and regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to Identify various methods of maintaining workshop safety<br>**Principles:** Students should understand and explain the following principles of safety in the workshop:<br>• Risk assessment,<br>• Hazard prevention,<br>• The importance of safety protocols<br>**Theories:** The students should explain: -<br>• workshop safety rules<br>• Purpose of each safety rule<br>• Different safety signs and their importance | The following tools, safety gear and equipment are to be available:<br>• Computer and internet connection<br>• Safety signs and labels<br>• Safety rules and regulations in the workshop<br>• OSHA regulation chart | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | workshop. | | | | | |
| | | (b) Maintaining personal safety | Interactive simulation and animation:<br>Guide students using simulations and animations to visualize safety gear and its uses, then discuss the importance in groups for engaging learning.<br>Practice<br>Guide students to apply safety gear in performing practical work | The students should be able to explain how to:<br>• Select tools, and equipment<br>• Select safety gear<br>• Apply safety gear in performing practical work<br>• Clean tools, equipment and safety gear<br>• Store tools, equipment and safety gear | Personal safety is maintained as per OSHA regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to maintain personal safety in the workshop<br>**Principles:** The students should explain the principles of: personal safety.<br>**Theories:** The students should explain: -<br>• Safety gear<br>• OSHA regulations | The following tools, safety gear and equipment are to be available:<br>• Computer<br>• Personal safety gear<br>• OSHA regulation chart<br>• Workshop safety rule | |
| | | (c) Maintaining safety gear record | **Interactive Demonstrations**<br>Guide students through interactive demonstrations to show how to create a safety gear inventory using tools like spreadsheets, logbooks, or specialized software. | The students should be able to:<br>• identify safety gear<br>• Record safety gear in the workshop ledger<br>• Keep records of safety gear | Safety gear record is maintained as per OSHA rules | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to maintain safety gear records<br>**Principle:** The students should explain how to maintain safety gear record<br>**Theories:** The students should | The following tools, safety gear and equipment are to be available:<br>: -<br>• Safety gear<br>• Computer<br>• Projector<br>• Log books | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | **Group discussion** Engage the students in a manageable group to discuss the importance of record-keeping for safety gear **Group Activities** Provide the templates to students for tracking Safety Gear | | | explain: - • Importance of keeping records of safety gear • Types of records • Components of effective record keeping • Best practice of record keeping | | |
| | 1.2 Handling Workshop Tools | (a) Classifying workshop tools | **Brainstorming** Guide the students in defining, identifying and describing why classifying workshop tools is important **Interactive simulation and animation:** guide students through visual aids to visualize various workshop tools | **The students should be able to:** • Identify various tools used in a workshop • Select tools, • Classify tools according to type and functions • Clean the tools • Store tools | Workshop tools are classified as per workshop standards and regulation | **Detailed knowledge of:** **Methods used**: The students should be able to explain how to classify tools **Principle:** the students should explain principle involved in storing tools **Theory:** students should be able to explain • Classification of workshop tools • Storage of tools • Keeping record of | The following tools, safety gear and equipment are to be available: • Projector • computer • Set of spanners • Set of screw drivers • Files • Tape measures • Hammer • Drilling machine • Drill machine • Combination | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | **Practice:**<br>Divide students into manageable groups for practising soughing of mixed workshop tools | | | tools<br>• Issuing procedure of tool | plier<br>• Side cutter<br>• Wire striper<br>• Electrician knife<br>• Clamp meter | |
| | | (b) Maintaining workshop tools | **Interactive simulation and animation:**<br>Guide students through interactive simulation and animation to visualise maintenance techniques on workshop tools<br><br>**Group discussion**<br>Guide students through manageable groups to arrange workshop tools<br><br>**Practice**<br>Divide students in manageable groups to practice maintaining of workshop tools | • Check the condition of the tools<br>• Identify tools requiring maintenance<br>• Observe safety precautions<br>• Clean tools, and safety gear<br>• Store tools, and safety gear.<br>• Observe safety measures | Workshop tools are maintained as per workshop standards and regulation | **Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to maintain workshop tools<br>**Principles:** The students should explain how to maintain workshop tools<br>**Theories:** The students should explain: -<br>• The importance of maintaining workshop tools.<br>• The importance of observing safety when using different tools. | The following tools, safety gear and equipment are to be available:<br>• Technician's tool kit<br>• Set of spanners<br>• Brushes<br>• Protective equipment<br>• Set of screw drivers<br>• Files<br>• Tape measures<br>• Hammer<br>• Drilling machine<br>• Gridding machine<br>• Combination plier<br>• Side cutter | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | 1.3 Handling workshop equipment | (a) Classifying workshop equipment | **Brainstorming** Guide the students in defining, identifying and describing the importance of workshop equipment<br><br>**Interactive simulation and animation:** Guide students through visual aids to visualize various workshop equipment<br><br>**Practice:** Divide students into manageable groups for practicing soughing of mixed workshop equipment | **The students should be able to:**<br>• Select tools and equipment<br>• Identify equipment used in the workshop<br>• Classify equipment according to type and function<br>• Clean equipment<br>• Store equipment | Equipment are classified as per functions | **Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to classify workshop equipment<br><br>**Principles:** The students should be able to Identify Safety protocols for classifying workshop equipment.<br><br>**Theories:** The students should be able to Understand the impact of using the correct tool on efficiency and safety. | The following tools, safety gear and equipment are to be available:<br>• Protective equipment<br>• Measuring equipment<br>• Instructional materials<br>• Workshop tools | 16 |
| | | (b) Maintaining workshop equipment | **Interactive simulation and animation:** Guide students through interactive simulation and | **The students should be able to:**<br>• Check condition of equipment<br>• Identify equipment | Workshop equipment is maintained as per manufacturer's manuals. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to maintain workshop | The following tools, safety gear and equipment are to be available:<br>• Insulation resistance tester | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | animation to visualise maintenance techniques on workshop equipment<br><br>**Group discussion**<br>Guide students through manageable groups to arrange workshop equipment<br><br>**Practice**<br>Divide students into manageable groups to practice maintaining workshop equipment | requiring maintenance<br>• Maintain the faulty equipment<br>• Test the equipment<br>• Observe safety precautions<br>• Clean equipment<br>• Store equipment | | equipment<br>**Principles:** The students should be able to explain how to inspect workshop equipment<br>**Theories:** The students should be able to explain<br>• Importance of maintenance for workshop equipment<br>• Electrical maintenance to workshop equipment<br>• Storage Environment of workshop equipment | • Multimeters<br>• Insulation resistance meter<br>• Protective equipments | |
| | 1.4 carrying out health and safety investigations | (a) Classifying accidents | **Brainstorm**<br>Guide students to brainstorm on different types of accident<br><br>**Case study**<br>Present to students scenarios of accidents and ask them to analyse and classify the | **The students should be able to:**<br>• Classify accident | Accident and Incidents are classified as per specified Standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to Classify an accident<br><br>**Principles:** The students should explain how to handle accidents and | The following tools, equipment and safety gear should be available: -<br>• computer with internet<br>• projector<br>• fire extinguisher | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | accidents based on the criteria<br><br>**Role-Playing**: Simulate accident scenarios for students to identify causes and classifications. | | | incidents.<br><br>**Theories:** The students should explain:<br>• Causes of accidents<br>• human error accident<br>• mechanical failure<br>• environmental factors<br>• system failure | | |
| | | (b) Identifying hazards | **Visual Aids**<br>Guide the students to visualize images or videos depicting common hazards in different environments (e.g., workshops, construction sites, offices).<br><br>**Group Discussions**<br>Encourage students to share their experiences | **The students should be able to explain how to:**<br>• Identify mechanical hazards<br>• Identify physical hazards<br>• Identify chemical hazards<br>• Identify electrical hazard | Hazards are identified as per specified Standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to identify hazards.<br>**Principles:** The students should explain principles involved in handling identify hazard<br>**Theories:** The students should explain how to handle: -<br>• Mechanical hazards<br>• Physical hazards | The following tools, safety gear and equipment are to be available:<br>:<br>• First aid box<br>• Overalls<br>• Hand gloves<br>• Masks<br>• Ear muffs<br>• Safety glasses<br>• Safety boots<br>• Helmets<br>• Fire extinguishers<br>• Electric Ladders | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | with workplace hazards.<br><br>**Brainstorm:** guide students to brainstorm solutions for minimizing or eliminating identified risks. | | | • Chemical hazards<br>• Electrical hazards<br>• Biological hazard | | |
| | | (c) Investigating an accident | **Case Studies** Guide students to discuss the steps to be taken during an accident investigation.<br><br>**Role-Playing** Assign roles to students such as investigator, witness, and injured party for simulating an accident investigation to practice interviewing witnesses, gathering evidence, and | **The students should be able to explain how to:**<br>• Investigate accidents | Accident and Incidents are investigated as per specified Standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to Investigate the accident<br>**Principles:** The students should explain the principles of Investigating an accident<br>**Theories:** The students should explain: -<br>• Accident investigation step<br>• Responsible authorities<br>• Police form number 3 | The following tools, safety gear and equipment are to be available:<br><br>• First aid box<br>• Overalls<br>• Hand gloves<br>• Masks<br>• Ear muffs<br>• Safety glasses<br>• Safety boots<br>• Helmets<br>• Fire extinguishers<br>• Electric Ladders | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | analyzing causes. | | | | | |
| | 1.5 handling fire accidents | (a) Performing fire Classification | **Visual Aids**<br>Use videos or image of fires for students to visualize different classes of fire.<br>**Hands-On Activities**<br>Prepare charts with Fire scenarios for students to describe the class of fire<br>**Group Discussions**<br>Prepare real-life fire incidents of fire and ask the students to discuss class of fire<br>**Role-Playing**<br>Simulate fire scenarios give to students to discuss class of fire<br>**Visit**<br>Let students visit fire Brigade to learn classes of | **The students should be able to:**<br>• Identify classes of fire | Fire accident is handled as per rules and regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to perform fire classification<br><br>**Principles:** The students should explain how to perform fire classification<br>**Theories:** The students should discuss: -<br>• Causes of fire<br>• Classification of fire<br>• Responsible authorities | The following tools, equipment and safety gear should be available: -<br>• First aid box<br>• Electric Ladders<br>• Firefighting equipment<br>• Safety boots<br>• Helmets<br>• Overalls<br>• Hand gloves<br>• Masks<br>• Ear muffs<br>• Safety glasses | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | fire | | | | | |
| | | (b) Performing firefighting | **Brainstorm**<br>Guide students to explore prior knowledge on different methods of fire extinguishing methods<br><br>**Visual Aids**<br>Guide students to visualize different methods of fire extinguishing methods<br><br>**Practice**<br>Prepare space and fire extinguishing gadgets for students to practice different methods of fire extinguishers | **The students should be able to explain how to:**<br>• Apply right class of firefighting materials<br>• Check and test fire extinguishers | Firefighting is performed as standard guideline | **Knowledge evidence: Detailed knowledge of:**<br><br>**Methods used**: The students should be able to explain how to perform firefighting<br>**Principles:** The students should explain how to perform firefighting<br>**Theories:** The students should explain:<br>• Fire extinguishers<br>• Responsible authority | The following tools, equipment and safety gear should be available:<br>• Computer with internet<br>• Projector<br>• Firefighting equipment<br>• Safety boots<br>• Helmets<br>• Overalls | |
| | | (c) Performing fire protection | **Study visit**<br>Guide students to visit facilities to identify potential fire hazard<br><br>**Group Activities**<br>Engage students into manageable | **The students should be able to explain how to:**<br>• Identify fire protection in building<br>• Testing the functionality | Fire protection is performed as per regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to perform fire protection<br>**Principles:** The | The following tools, safety gear and equipment are to be available:<br>-<br>• First aid box<br>• Electric Ladders | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | groups to discuss improvements to be made to prevent fire hazard and ensure safety measures are in place | of firefighting equipment | | students should explain how to perform fire protection<br>**Theories:** The students should explain the:<br>• Importance of fire detectors<br>• Fire suppression system<br>• Fire containment<br>• Fire escaping routes | • Firefighting equipment<br>• Safety boots<br>• Helmets<br>• Overalls<br>• Hand gloves<br>• Masks<br>• Ear muffs<br>• Helmets<br>• Overalls<br>• Hand gloves<br>• Masks<br>• Ear muffs<br>• Safety glasses | |
| | 1.6 Performing first aid | (a) Maintaining first aid kit | **Brainstorm**<br>Guide students to discuss check list of first Aid kit<br><br>**Visual Aids**<br>Guide students through visual aids to visualize images of a well-organised first aid kit, showing how items should be arranged<br><br>**Group work**<br>Divide students to manageable groups, give them | **The students should be able to explain how to:**<br>• Locate first Aid kit<br>• Identify first Aid requirements | First aid is maintained as per rules and regulations | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to maintain first Aid kit<br>**Principles:** The students should explain how to maintain first Aid kit<br>**Theories:** The students should explain:<br>• Content of first Aid kit<br>• Location of first Aid kit | The following tools, safety gear and equipment are to be available:<br>• First aid kits<br>• Safety boots<br>• Stretcher<br>• Safety glasses<br>• Rubber gloves<br>• Overall<br>• Ladders | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | first Aid kit for accounting | | | | | |
| | | (b) Performing artificial respiration | **Visual Aids** Guide students through visual aids to visualize video showing how to give artificial respiration to a person with respiration difficulties | **The students should be able to explain how to:**<br>• Identify materials<br>• Select artificial respiration<br>• Perform artificial respiration<br>• Report the incident to supervisor | First aid are performed as per rules and regulations | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students be able to should explain how to perform artificial respiration<br>**Principles:** The students should explain how to perform artificial respiration **Theories:** The students should explain:<br>• Types of artificial respiration<br>• Steps of performing artificial respiration | The following tools, safety gear and equipment are to be available:<br>• First aid kits<br>• Gloves<br>• CPR Mask | |
| | | (c) Performing first aid to minor injuries | **Visual Aids** Guide the students to visualize step-by-step of treating specific injuries, such as burns, sprains, and cuts.<br>**Role-Playing** Prepare | **The students should be able to explain how to:**<br>• Identify the nature of injury<br>• Identify the required treatment<br>• Perform first | First aid is performed as per rules and regulations | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students be able to should explain how to perform first aid to minor injuries<br>**Principles:** The students should Learn | The following tools, safety gear and equipment are to be available:<br>• First aid kits<br>• gloves | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | mannequins to simulate injury scenarios for students to work out the steps of administering first aid. | Aid to injure person | | how to apply the fundamental principles of first aid when perform first aid to minor injuries<br>**Theories:** The students should explain: -<br>• Steps of performing first aid for minor injuries<br>• Identify nature of injuries<br>• Treat/give first Aid to minor injury | | |
| | 1.7 Maintaining buildings | (a) Performing arrangement of fittings and fixtures for the buildings | **Visual Aid**<br>Guide the students to visualize the how to arrange fittings and fixture<br><br>**Group activities**<br>Engage the students in manageable groups and give them a floor plan drawing of the building to practice arrange of fittings and | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear.<br>• Identify fittings and fixtures<br>• Arrange fitting and fixture<br>• Clean tools, equipment and safety gear.<br>• Store tools, equipment and | Fixtures and fittings are arranged as per specified standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able explain how to perform arrangement of fittings and fixtures for the buildings<br>**Principles:** The students should explain how to Perform arrangement of fittings and fixtures for the | The following tools, safety gear and equipment are to be available:<br>• Polyethylene bags<br>• Incinerator<br>• Overall<br>• Dust Bin<br>• Gloves<br>• Mask<br>• Dust collectors<br>• Exhaust fans<br>• Safety boots | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | fixtures<br><br>**Visit**<br>Let students visited the workshop/building to realize fixtures and fitting arrangement | safety gear. | | buildings<br>**Theories:** The students should explain: -<br>The essence of arranging fittings and fixtures in a building | | |
| | | (b) Performing interior and exterior cleanliness | **Brainstorm**<br>Guide students to discuss the type of abnormality in the building environment<br><br>**Visual Aids**<br>Guide the students to visualize the cleaning of the interior and exterior of the building<br><br>**Practice**<br>Engage the students in groups to practice interior and exterior cleaning of the building | The students would be able to explain how to:<br>• Select tools, equipment, materials and safety gear<br>• Identify building abnormality<br>• Perform interior and exterior cleaning<br>• Observe safety precautions<br>• Clean tools, equipment safety gear and workplace.<br>• Store tools and equipment. | Interior and exterior of the building are cleaned as per requirement | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to perform interior and exterior cleanliness<br>**Principles:** The students should explain how to perform interior and exterior cleanliness<br>**Theories:** The students should explain:<br>• Steps of interior building cleaning<br>• Steps of exterior building cleaning<br>• Segregation of waste | The following tools, safety gear and equipment are to be available:<br><br>• Brooms<br>• Wheelbarrow<br>• Spade<br>• Rake<br>• Polyethylene bags<br>• Incinerator<br>• Overall<br>• Dust Bin<br>• Gloves<br>• Mask<br>• Dust collectors<br>• Safety boots | |
| | 1.8 Maintaining a safe | (a) Cleaning workshop | **Brainstorm**<br>**Guide students to** | **The students should be able to** | workshop environment is | **Knowledge evidence: Detailed knowledge** | The following tools, equipment | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | working environment | environment | **discuss**<br>• Types of machineries and appliance available in the workshop<br>• Common dirty found in the workshop<br>• Possible hazard in the workshop<br><br>**Visual Aid:**<br>Guide the students to visualize documentary which shows how to clean of the workshop<br><br>**Practice:**<br>Engage the students in a small manageable group to practice cleaning of workshop | **explain how to:**<br>• Select relevant safety gear<br>• Maintain workshop safety<br>• Identify causes of hazards in a working environment<br>• Maintain safe working environment | cleaned as per safety rules and regulations | **of:**<br>**Methods used**: The students should be able to explain how to cleaning workshop environment<br>**Principles:** The students should explain how to cleaning workshop environment<br>**Theories:** The students should explain: -<br>• Hazard in workshop environment<br>• Steps of cleaning workshop | and safety gear should be available: -<br>• Safety boots<br>• Hand gloves<br>• Overalls<br>• Firefighting equipment<br>• Dust mask | |
| | | (b) Drawing safety signs | **Brainstorming**<br>Guide the students in defining, identifying and describing various | **The students should be able to explain how to:**<br>• Interpret safety signs | Safety signs are drawn as per safety rules and regulations | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be | The following tools, equipment and safety gear should be available: - | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | safety sign drawings<br>**Visual Aid**<br>Guide the students to visualise the documentary which shows various safety sign drawings<br><br>**Practice**<br>**Group Activities**<br>Engage the students in a small manageable group to practice drawing safety sign | • Draw safety signs | | able to explain how to draw workshop sign<br>**Principles:** The students should explain how to draw workshop sign<br>**Theories:** The students should explain: -<br>• Meaning of safety sign<br>• Types of safety signs<br>• Importance of safety sign<br>• Application of safety sign | • Safety sign charts<br>• Workshop layout plan<br>• Drawing instruments and materials | |
| | | (c) Handling waste | **Brainstorm**<br>Guide students to discuss types of waste in the workshop<br><br>**Visual Aids**<br>Guide the students to visualize a documentary showing means of disposing of waste<br><br>**Practice**<br>Engage the students in a small | **The students should be able to explain how to:**<br>• Select tools and equipment<br>• Identify dustbins<br>• Dispose of waste as per OHS<br>• Observe safety precautions<br>• Clean, tools, equipment, safety gear and work place | Waste is handled as per the guideline | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to handle waste<br>**Principles:** The students should explain how to handle waste<br>**Theories**: The students should be able to explain<br>• Type of dustbin<br>• Common types of | The following tools, equipment and safety gear should be available:<br>• Brooms<br>• Brushes<br>• Dust bins<br>• Mops<br>• Mop bucket<br>• Hoe<br>• Hoovers<br>• Safety boots<br>• Hand gloves<br>• Overalls<br>• Dust mask | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | manageable group to practice various methods of disposing of waste | • Store tools, equipment and safety gear. | | wastes and their hazards<br>• Steps of separating waste | | |
| 2.0 Performing preventive maintenance of tools, equipment and machines. | 2.1 Performing preventive maintenance of electrical tools | (a) maintaining Workshop Safety Gear | **Brainstorming:** guides the students in defining, identifying and describing various faults/brock in safety gear<br><br>**Visual Aids**<br>Guide the students to visualize a documentary which shows the maintenance of safety gear<br><br>**Practice**<br>Engage the students in a small manageable group to practice the maintenance of safety gear | **The students should be able to:**<br>• Select tools<br>• Interpret maintenance schedule chart.<br>• Identify faults in safety gear.<br>• Maintain safety gear<br>• Observe safety precautions.<br>• Clean tools, equipment, machines and workplace.<br>• Store tools and equipment. | Workshop safety Gear is maintained as per the manufacturer's specifications. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to maintain Workshop Safety Gear.<br>**Principles:** The students should explain how the Workshop maintains safety Gear.<br>**Theories:** The students should explain:<br>• Preventive maintenance.<br>• Importance of maintenance schedule.<br>• Preparation of warning tags.<br>• Common faults on safety gear<br>• Steps of maintaining safety gear | The following safety equipment should be available:<br>• Assorted power-operated hand tools.<br>• Assorted automatic tool kits.<br>• Maintenance schedule chart.<br>• Waste bin.<br>• Blower.<br>• Sprit can.<br>• Safety clear glasses.<br>• Gloves.<br>• Over Coat. | 16 |
| | | (b) Maintain | **Brainstorming** | **The students** | Electrical hand | **Knowledge evidence:** | The following | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | electrical hand tools | Guide, the students to discuss various faults/brock in electrical hand tools<br><br>**Visual Aids**<br>Guide the students to visualize a documentary which shows the maintenance of electrical hand tools<br><br>**Practice**<br>Engage the students in a small manageable group to practice the maintenance of electrical hand tools | **should be able to:**<br>• Select tools<br>• Interpret maintenance schedule chart.<br>• Identify faults in hand tools.<br>• Maintain hand tools<br>• Observe safety precautions.<br>• Clean tools, equipment, machines and workplace.<br>• Store tools and equipment. | tools are maintained as per the manufacturer's specifications. | **Detailed knowledge of:**<br>**Methods used**: The students should explain how to maintain electrical hand tools.<br>**Principles:** The students should explain how Maintain electrical hand tools.<br>**Theories:** The students should explain:<br>• Common faults in electrical hand tools<br>• Steps of maintaining electrical hand tools | tools, safety gear and equipment are to be available:<br>• Assorted automatic tool kits.<br>• Maintenance schedule chart.<br>• Waste bin.<br>• Blower.<br>• Sprit can.<br>• Safety clear glasses.<br>• Gloves.<br>• Over Coat. | |
| | | (c) Maintain measuring tools | **Brainstorming**<br>Guide, the students define, identify and describe various faults in measuring tools<br><br>**Visual Aids**<br>Guide the students | **The students should be able to:**<br>• Select tools<br>• Interpret maintenance schedule chart.<br>• Identify faults in measuring tools | measuring tools are maintained as per the manufacturer's specifications. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to maintain measuring tools<br><br>**Principles:** The | The following tools, safety gear and equipment are to be available:<br>• Assorted power-operated hand tools.<br>• Assorted | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | to visualize a documentary which shows the maintenance measuring tools<br><br>**Practice**<br>Engage the students in small, manageable groups to practice maintaining measuring tools | • Maintain measuring tools<br>• Observe safety precautions.<br>• Clean tools, equipment, machines and workplace.<br>• Store tools and equipment. | | students should explain how maintain measuring tools.<br>**Theories:** The students should explain:<br>• Common faults in measuring tools<br>• Steps of maintaining measuring tools | automatic tool kits.<br>• Maintenance schedule chart.<br>• Waste bin.<br>• Blower.<br>• Sprit can.<br>• Safety clear glasses.<br>• Gloves.<br>• Over Coat. | |
| | 2.2 Performing preventive maintenance of basic electrical equipment | (a) Maintain Passive equipment. | **Brainstorming**<br>Guides the students in defining, identifying and describing various faults in passive equipment<br>**Visual Aids**<br>Guide the students to visualize a documentary which shows the maintenance of passive equipment<br><br>**Practice**<br>Engage the students in small, manageable groups to practice | **The students should be able to:**<br>• Select tools, equipment and safety gear.<br>• Categorize equipment.<br>• Identify equipment faults.<br>• Rectify faulty equipment.<br>• Observe safety precautions.<br>• Clean tools and equipment.<br>• Store tools and equipment. | Passive equipment is maintained as per the manufacturer's specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to maintain Passive equipment.<br>**Principles:** The students should explain the importance of regular maintenance to ensure the longevity and efficiency of passive equipment.<br>**Theories:** The students should explain:<br>• Common faults in Passive | The following tools, safety gear and equipment are to be available:<br>• Store room.<br>• Tool racks.<br>• Cabinets.<br>• Toolboxes.<br>• Tool shelves.<br>• Workbench.<br>• Service manuals.<br>• Store ledgers.<br>• Assorted Equipment.<br>• Vice.<br>• Sprit can.<br>• Over-coat.<br>• Gloves.<br>• Safety clear | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | maintenance of passive equipment | | | equipment.<br>• Types of maintenance in passive equipment.<br>• Types of passive equipment in the workshop.<br>• Use of passive equipment in the workshop. | glasses. | |
| | | (b) Maintain Active Equipment. | **Brainstorm**<br>Identify active equipment in the workshop<br>**Demonstrate how to** perform preventive maintenance of active equipment<br>**Practice**<br>Perform preventive maintenance of active equipment | **The students should be able to:**<br>• Select tools, equipment and safety gear.<br>• Categorize active equipment.<br>• Identify active equipment faults.<br>• Rectify faults in active equipment.<br>• Observe safety precautions.<br>• Clean tools and equipment.<br>• Store tools and equipment. | Active equipment is maintained as per manufacturer's specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to maintain active equipment.<br><br>**Principles:** The students should Understand the importance of regular maintenance to ensure the optimal performance and longevity of active equipment.<br><br>**Theories:** The students should explain: | The following tools, equipment and safety gear are be available:<br>• Tool racks.<br>• Cabinets.<br>• Tool boxes.<br>• Tool shelves.<br>• Work bench.<br>• Service manuals.<br>• Store ledgers.<br>• Assorted Equipment's.<br>• Vice.<br>• Sprit can.<br>• Over-coat.<br>• Gloves.<br>• Safety clear glasses. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | | | | • Common faults in active equipment.<br>• Types of maintenance for active equipment.<br>• Types of active equipment in the workshop.<br>• Use of active equipment in the workshop. | | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | 2.3 Performing preventive maintenance of simple electric machines | (c) Maintain power machines. | **Brainstorming** guides the students to define, identify and describe various faults in power machines<br><br>**Visual Aids**<br>Guide the students to visualize a documentary which shows the maintenance of power machines<br><br>**Practice**<br>Engage the students in small, manageable groups to practice the maintenance of power machines | **The students should be able to:**<br>• Select tools, equipment and safety gear.<br>• Categorize power machines<br>• Identify power machine faults.<br>• Rectify faults in power machines<br>• Observe safety precautions.<br>• Clean tools and equipment.<br>• Store tools and equipment. | The power machine is maintained as per the manufacturer's specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to maintain power machines.<br>**Principles:** The students should Learn how to identify and diagnose common issues and faults in power machines<br>**Theories:** The students should explain:<br>• Common faults in power machines<br>• Types of maintenance for power machines<br>• Use of power machines in the workshop. | The following tools, safety gear and equipment are to be available:<br><br>• Store room.<br>• Tool racks.<br>• Cabinets.<br>• Toolboxes.<br>• Tool shelves.<br>• Workbench.<br>• Service manuals.<br>• Store ledgers.<br>• Assorted Equipment.<br>• Vice.<br>• Spirit can.<br>• Over-coat.<br>• Gloves.<br>• Safety clear glasses. | 16 |
| | | (d) Maintain manual machines. | **Brainstorming** guides the students in defining, identifying and describing various faults in manual | **The students should be able to:**<br>• Select tools, equipment and safety gear.<br>• Categorize manual | The manual machine is maintained as per the manufacturer's specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to maintain manual | The following tools, safety gear and equipment are to be available:<br>• Store room.<br>• Tool racks.<br>• Cabinets. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | machines<br><br>**Visual Aids**<br>Guide the students to visualize a documentary which shows the maintenance of a manual machine<br><br>**Practice**<br>Engage the students in a small manageable group to practice maintenance of manual machine | machines<br>• Identify manual machine faults.<br>• Rectify faults in manual machines<br>• Observe safety precautions.<br>• Clean tools and equipment's.<br>• Store tools and equipment. | | machines.<br><br>**Principles:** The students should explain how to manual machines<br>**Theories:** The students should explain:<br>• Common faults in manual machines<br>• Types of maintenance for power machines<br>• Use of manual machines in the workshop. | • Tool boxes.<br>• Tool shelves.<br>• Work bench.<br>• Service manuals.<br>• Store ledgers.<br>• Assorted Equipment's.<br>• Vice.<br>• Sprit can.<br>• Over-coat.<br>• Gloves.<br>• Safety clear glasses. | |
| 3.0 Performing bench works | 3.1 Performing machining operations | (a) Performing metal grinding | **Visual Aids**<br>Guide the students to visualize the use of pieces of machinery to grind metal to the required size.<br><br>**Show** students how to grind metal to the required size<br><br>**Practical work:**<br>Organise the | **The students should be able to:**<br>• Interpret the drawing.<br>• Select the material, tools and equipment.<br>• Mark the workpiece.<br>• Clamp the workpiece on a vice.<br>• Mark the start groove with a triangle file | Metal sheet grinding is performed as per the given specifications and standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform metal grinding<br>**Principles:** The students should explain principles related to performing metal grinding<br>**Theories:** The students should | The following tools, safety gear and equipment are to be available:<br>▪ Workbench.<br>▪ Bench vice.<br>▪ Try square.<br>▪ Vernier calliper.<br>▪ Steel rule.<br>▪ Hacksaw.<br>▪ Centre punch.<br>▪ Oil can.<br>▪ Radius gauges. | 24 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | students in a small manageable group to practice metal grinding. | • Remove sharp edges with a file.<br>• Take measurements for accuracy.<br>• Apply safety measures.<br>• Clean the workplace, work pieces and tools.<br>• Store the workpiece and tools. | | explain:<br>• Types of grinding stones and their functions.<br>• The uses of various tools and equipment. | ▪ Spring divider.<br>▪ Scriber.<br>▪ Scriber surface table.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses. | |
| | | (b) Performing hole drilling | **Visual Aids**<br>Guide the students to visualize the use of machinery to drill holes in piecework.<br><br>**Show** students how to drill holes in piecework.<br><br>**Practical work:**<br>Organise the students in a small manageable group to practice drill hole-in-piece work. | **The students should be able to:**<br>• Interpret the drawing.<br>• Select the material, tools and equipment.<br>• Mark the workpiece.<br>• Clamp the workpiece on a vice.<br>• Mark the start groove with a triangle file.<br>• Perform drilling.<br>• Remove sharp | Hole drilling is performed as per technical specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform hole drilling<br>**Principles:** The students should explain principles related to hole drilling<br>**Theories:** The students should explain:<br>• Types of drill bit and their functions.<br>• Main parts of a | This element can be achieved at the school workshop and the following tools, equipment and safety gear are to be available:<br>▪ Workbench.<br>▪ Bench vice.<br>▪ Try square.<br>▪ Vernier caliper.<br>▪ Steel rule.<br>▪ Hacksaw.<br>▪ Centre punch.<br>▪ Oil can.<br>▪ Radius | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | | edges with a file.<br>• Measure accuracy.<br>• Apply safety measures.<br>• Clean the workplace, workpieces and tools.<br>• Store the workpiece and tools. | | drill bit.<br>**Circumstantial knowledge:**<br>**Detailed knowledge about:**<br>• Preventive maintenance of tools, equipment and machines.<br>• Environmental requirements.<br>• Properties of metal materials | gauges.<br>▪ Spring divider.<br>▪ Scriber.<br>▪ Scriber surface table.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses. | |
| | 3.2 Performing forming operation | (a) Performing Metal Cutting | **Visual Aids**<br>Guide the students to visualize machinery used in metal cutting<br><br>**Show** students how to cut metal to the required size.<br><br>**Practical work:**<br>Organise the students in a small manageable group to practice metal cutting. | **The students should be able to:**<br>• Interpret the drawing.<br>• Select the material, tools and equipment.<br>• Mark the workpiece.<br>• Clamp the workpiece on a vice.<br>• Mark the start groove with a triangle file.<br>• Perform metal cutting.<br>• Remove sharp edges with a file. | Metal-cutting is performed as per technical specifications. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform metal cutting<br>**Principles:** The students should explain principles related to performing metal-cutting<br>**Theories:** The students should explain:<br>• Types of metal cutting tools and their functions.<br>• Main parts of a metal cutting | The following tools, equipment and safety gear are to be available:<br>▪ Workbench.<br>▪ Bench vice.<br>▪ Try square.<br>▪ Vernier caliper.<br>▪ Steel rule.<br>▪ Hacksaw.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses.<br>▪ Files.<br>▪ Scriber. | 32 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | | • Measure accuracy.<br>• Apply safety measures.<br>• Clean the workplace, workpieces and tools | | tool.<br>• The uses of various tools and equipment. | ▪ Wire brush. | |
| | | (b) Performing Metal Shearing | **Visual Aids**<br>Guide the students to visualize machinery used in metal shearing<br><br>**Show** students how to metal shearing.<br><br>**Practical work:**<br>Organise the students in a small manageable group to practice metal shearing. | **The students should be able to:**<br>• Interpret the drawing.<br>• Select the material, tools and equipment.<br>• Mark the workpiece.<br>• Clamp the workpiece on a vice.<br>• Mark the start groove with a triangle file.<br>• Perform metal shearing<br>• Remove sharp edges with a file.<br>• Take measurements for accuracy.<br>• Apply safety measures. | Metal shearing is performed as per technical specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform metal shearing<br>**Principles:** The students should explain principles related to performing metal shearing<br>**Theories:** The students should explain:<br>• Types of metal shearing tools and their functions.<br>• Main parts of a metal shearing machine.<br>• The uses of various tools and equipment. | The following tools, equipment and safety gear are to be available:<br>▪ Workbench.<br>▪ Bench vice.<br>▪ Try square.<br>▪ Vernier caliper.<br>▪ Steel rule.<br>▪ Hacksaw.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses.<br>▪ Files.<br>▪ Scriber.<br>▪ Wire brush.<br>▪ Shear machine | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | | • Clean the workplace, workpieces and tools | | | | |
| | | (c) Performing metal bending | **Visual Aids**<br>Guide the students to visualize machinery used in metal bending.<br><br>**Show** students how to bend the metal.<br><br>**Practical work:**<br>Organise the students in a small manageable group to practice metal bending. | **The students should be able to:**<br>• Interpret the drawing.<br>• Select the material, tools and equipment.<br>• Mark the workpiece.<br>• Clamp the workpiece on a vice.<br>• Mark the start groove with a triangle file.<br>• Perform metal bending<br>• Remove sharp edges with a file.<br>• Measure accuracy.<br>• Apply safety measures.<br>• Clean the workplace, workpiece and tools | Metal bending is performed as per technical specifications. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform metal bending<br>**Principles:** The students should explain principles related to performing metal bending<br>**Theories:** The students should explain:<br>• Types of metal bending tools and their functions.<br>• Main parts of a metal bending machine.<br>• The uses of various tools and equipment. | The following tools, equipment and safety gear are to be available:<br>▪ Workbench.<br>▪ Bench vice.<br>▪ Try square.<br>▪ Vernier caliper.<br>▪ Steel rule.<br>▪ Hacksaw.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses.<br>▪ Files.<br>▪ Scriber.<br>▪ Wire brush.<br>▪ Manually/hydraulic Bending machine | |
| | | (d) Constructing | **Visual Aids** | **The students** | The sheet metal | **Knowledge evidence:** | The following | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | Sheet Metal Boxing | Guide the students to visualize machineries used in sheet metal boxing making<br><br>**Show** students how to make metal sheet box.<br><br>**Practical work:** Organise the students in a small manageable group to practice sheet metal boxing making | **should be able to:**<br>• Interpret the drawing.<br>• Select the material, tools and equipment.<br>• Mark the work piece.<br>• Clamp the workpiece on a vice.<br>• Construct Sheet metal boxing<br>• Remove sharp edges with a file.<br>• Take measurements for accuracy.<br>• Apply safety measures.<br>• Clean the work place, work pieces and tools | box is performed as per technical specifications. | **Detailed knowledge of:**<br>**Methods used**: The students should explain how to construct sheet metal boxing<br>**Principles:** The students should explain principles related to constructing sheet metal boxing<br>**Theories:** The students should explain:<br>• Types of cutting blade and their functions.<br>• Main parts of a hand saw frame.<br>• Hand sawing blade teeth arrangement.<br>• The uses of various tools and equipment. | tools, equipment and safety gear are to be available:<br>▪ Workbench.<br>▪ Bench vice.<br>▪ Try square.<br>▪ Vernier calliper<br>▪ Steel rule.<br>▪ Hacksaw.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses.<br>▪ Files.<br>▪ Scriber.<br>▪ Wire brush. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | 3.3 Performing surface finishing operation | (a) Carrying out sanding | **Visual Aids**<br>Guide the students to visualize materials used in smoothing the surface of work piece<br><br>**Show** students how to smooth the surface of the workpiece.<br><br>**Practical work:**<br>Organise the students in a small manageable group to practice works piece surface smoothing | **The students should be able to:**<br>• Select the material, tools and equipment.<br>• Mark the work piece.<br>• Clamp the work piece.<br>• Perform surface finishing by sanding<br>• Apply safety measures.<br>• Clean the work place and work piece.<br>• Store the work piece, tools and equipment. | Sanding for finishing a work piece carried out as per technical specifications. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to carry out sanding<br>**Principles:** The students should explain principles related to sanding<br>**Theories:** The students should explain:<br>• The uses of various tools and equipment used in the sanding.<br>• Types of sanding machines. | The following tools, equipment and safety gear are to be available:<br>▪ Workbench.<br>▪ Bench vice.<br>▪ Metal belt sanding machine<br>▪ Polishing belt sander<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses. | 24 |
| | | (b) Carrying out filing | **Visual Aids**<br>Guide the students to visualize the use of different sizes and shapes of filling in resizing the metal piece.<br><br>**Show** students how to resize the piecework | **The students should be able to:**<br>• Interpret the technical drawing.<br>• Select the material, tools and equipment for filling<br>• Clamp the workpiece.<br>• Perform filling | A work piece filed as per technical specifications. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to carry out filling<br>**Principles:** The students should explain principles related to filling<br>**Theories:** The | The following tools, equipment and safety gear are available:<br>▪ Workbench.<br>▪ Bench vice.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | according to drawings.<br><br>**Practical work:** Organise the students in a small manageable group to practice metal resizing using various files. | • Apply safety measures.<br>• Clean the work place and work piece.<br>• Store the work piece, tools and equipment. | | students should explain:<br>• Advantages of filling.<br>• Types of files | ▪ Metal file<br>▪ Metal work peace | |
| | 3.4 Performing bearing removal and mounting | (a) Mounting bearing Manually | **Demonstration** Show students step by step process of mounting a bearing manually.<br><br>**Group Activity** Assign group of students to practice mounting of bearings varying shaft sizes | **The students should be able to:**<br>• Select tools, equipment and safety gear.<br>• Prepare shaft onto which to fit bearing<br>• Select bearing to be fitted.<br>• Mount bearing onto shaft.<br>• Observe safety requirements.<br>• Clean the workplace and work pieces.<br>• Store tools, equipment and safety gear. | Mounting of bearing conforms to given instructions and manufacturer specifications | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to mount bearing manually<br>**Principles:** The students should explain principles related to mounting bearing manually<br>**Theories:** The students should explain:<br>• Importance of using bearings in rotating machine parts<br>• The use of various tools and equipment when removing and | The following tools, equipment and safety gear are be available;<br>▪ Workbench.<br>▪ Bearing removal and mounting kit<br>▪ Puller<br>▪ Oil can<br>▪ Grease gun<br>▪ Bearing servicing kit<br>▪ Radius gauges.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses. | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | | | | mounting bearings<br>• How to remove and mount bearings | | |
| | | (b) Mounting bearing Mechanically | **Demonstration**<br>Show students the step-by-step process of mounting a bearing mechanically.<br>**Group Activity**<br>Assign group of students to practice mounting of bearings varying shaft sizes | **The students should be able to:**<br>• Select tools, equipment and safety gear.<br>• Prepare shaft onto which to fit bearing<br>• Select bearing to be fitted.<br>• Mount bearing onto shaft.<br>• Observe safety requirements.<br>• Clean the work place and work pieces.<br>• Store tools, equipment and safety gear. | Mounting of bearing mechanically conforms to given instructions and manufacturer specifications | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to mount bearing mechanically<br>**Principles:** The students should explain principles related to mounting bearing mechanically<br>**Theories:** The students should explain:<br>• Importance of using bearings in rotating machine<br>• The use of various tools and equipment when mounting bearings<br>• How to mount bearings | The following tools, equipment and safety gear are be available:<br>▪ Workbench.<br>▪ Bearing removal and mounting kit<br>▪ Puller<br>▪ Oil can<br>▪ Grease gun<br>▪ Bearing servicing kit<br>▪ Radius gauges.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Hydraulic press<br>▪ Safety glasses. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | (c) Removing bearing Mechanically | **Demonstration**<br>Demonstrate the process of removing bearing step by step.<br><br>**Group Activity**<br>Assign a group of students to practice removing of bearings | **The students should be able to:**<br>• Select tools, equipment and safety gear.<br>• Prepare the shaft onto which to remove the bearing<br>• Select the bearing to be removed.<br>• Remove bearing from shaft.<br>• Use a puller to remove the bearing from the shaft.<br>• Observe safety requirements.<br>• Clean the workplace and workpieces.<br>• Store tools, equipment and safety gear. | Removal of bearing conforms to given instructions and manufacturer specifications | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to remove the bearing mechanically<br>**Principles:** The students should explain principles related to removing bearings mechanically<br>**Theories:** The students should explain:<br>• Importance of using bearings in rotating machine<br>• The use of various tools and equipment when removing bearings<br>• How to remove bearings | the following tools, equipment and safety gear are to be available:<br>▪ Workbench.<br>▪ Bearing removal and mounting kit<br>▪ Puller<br>▪ Oil can<br>▪ Grease gun<br>▪ Bearing servicing kit<br>▪ Radius gauges.<br>▪ Leather gloves.<br>▪ Overall.<br>▪ Safety boots.<br>▪ Safety glasses | |
| | 3.5 Performing threading. | (a) Performing tapping. | **Brainstorming**<br><br>Guide the students in defining, identifying and | **The students should be able to:**<br>• Interpret the drawing.<br>• Prepare the | Tapping is performed as per specifications | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should | The following tools, equipment, safety gears and machine should be available: | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | describing various types of taps and their specific applications<br><br>**Demonstration**<br>Show students how to perform manual tapping on a pre-drilled hole,<br><br>**Practice**<br>Engage the students in a small manageable group to use tapping machines or drill presses under supervision. | blanks.<br>• Undertake tapping.<br>• Take measurements.<br>• Mark.<br>• Punch.<br>• Drill the hole as per Tap drill size<br>• Perform tapping<br>• Clean the workplace/workpiece.<br>• Store the workplace, work pieces and tools. | | explain how to perform tapping<br>**Principle:** students should be able to explain how to perform tapping<br>**Theories:** The students should explain:<br>• The Types of taps in a set.<br>• Materials for the manufacture of taps and dies.<br>• The importance of applying oils when threading.<br>• Standard thread.<br>• Calculations required. | • Bench vice.<br>• Drilling machine.<br>• Centre punch.<br>• Lathe machine.<br>• Hammer.<br>• Scriber.<br>• Set of taps.<br>• Tap wrench.<br>• Try square.<br>• Dies.<br>• Centre drill.<br>• Drill bit.<br>• Drill chuck.<br>• Overall.<br>• Safety boots.<br>• Safety glasses.<br>• Cap.<br>• Leather gloves.<br>• Machine vice.<br>• Safety gear.<br>• Turning tool.<br>• Vernier caliper.<br>• Thread plug gauge.<br>• Thread ring gauge.<br>• Thread pitch | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | | | | | gauge. | |
| | | (b) Performing Die cutting. | **Brainstorming**<br><br>Guide the students in defining, identifying and describing various types of die cutting and their specific applications<br><br>**Demonstration**<br>Show students how to perform die cutting<br><br>**Practice**<br>Engage the students in manageable groups practice manual die cutting. | **The students should be able to explain how to:**<br>• Interpret the drawing.<br>• Prepare the blanks.<br>• Undertake die cutting.<br>• Perform die cutting<br>• Clean the workplace/work piece.<br>• Store the work place, work pieces and tools. | Die cutting is performed as per specifications | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform die cutting<br><br>**Principle:** The students should be able to Understand the significance of following safety protocols to prevent accidents and injuries during die cutting.<br>**Theories:** The students should explain:<br>• Types of die cutting.<br>• Materials for the manufacture of dies.<br>• The importance of applying oils when threading.<br>• Pressure and cutting forces<br>• Steps for die cutting | The following tools, safety gear and equipment are to be available:<br>• Bench vice.<br>• Drilling machine.<br>• Centre punch.<br>• Lathe machine.<br>• Hammer.<br>• Scriber.<br>• Set of taps.<br>• Tap wrench.<br>• Try square.<br>• Dies.<br>• Centre drill.<br>• Drill bit.<br>• Drill chuck.<br>• Overall.<br>• Safety boots.<br>• Safety glasses.<br>• Cap.<br>• Leather gloves.<br>• Machine vice.<br>• Safety gear.<br>• Turning tool.<br>• Vernier caliper. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge Assessment | | |
| | | | | | | | • Thread plug gauge.<br>• Thread ring gauge.<br>• Thread pitch gauge. | |

## Form Two

**Table 4***: Detailed Contents for Form Two*

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| 1.0 Selecting solar PV system components | 1.1 Specifying solar PV system major components | (a) Specifying solar PV module | **Brainstorm**<br>Guide the students in defining, identifying and describing<br>• energy from the sun<br>• rotation of the earth around the sun<br>• rotation of the earth on its orbit night<br>• Differentiate solar PV modules<br>**Practice**<br>Provide **students with**<br>• datasheets of various PV modules for interpreting key specifications and comparing modules | **The students should be able to explain how to:**<br>• Select tools and equipment required<br>• Interpret nameplate data<br>• Count the number of cells in the solar module<br>• Read the manufacturer's specification | solar PV module is specified as per the manufacturer's specification | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should be engaged in practical demonstrations to understand the specifications of solar PV modules.<br>**Principles:** The students should state<br>• the basic principles of photovoltaic (PV) system<br>• the factors affecting module efficiency<br>• the importance of selecting the right specifications for solar PV modules based on the application and location.<br>**Theories:** The students should explain:<br>• the theoretical | The following tools, safety gear and equipment are to be available:<br>• Multimeter<br>• Monocrystalline PV Module<br>• Polycrystalline PV Module<br>• Amorphous PV Module<br>• Set of screwdrivers<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench.<br>• Datasheet or technical manuals | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | • solar PV panel to read nameplate information and count the number of cells in PV modules<br>**Group activities**<br>Engage the students in groups to propose solutions to solar panels installed under shading or irregular orientations | | | knowledge of how solar PV modules generate electricity<br>• Types of solar panels available and their differences<br>• the environmental and economic benefits of using solar PV modules.<br>• Function of bypass and blocking diode | | |
| | | (b) Specifying solar battery | **Brainstorm**<br>Guide students to discuss devices that use batteries as the source of power<br>**Practice**<br>provide students with batteries to<br>• Interpret nameplate information<br>• Measure battery voltage | **The students should be able to explain how to:**<br>• Select tools and equipment required<br>• Interpret nameplate data<br>• Calculate battery capacity in Wh or Ah<br>• Read the manufacturer's specification<br>• Measure battery voltage | The solar battery is specified as per manufacturer's specification | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to discuss Solar battery specifications.<br>**Principles:** The students should discuss the Charging and discharging principle of solar battery<br>**Theories:** The students should explain: | The following tools, safety gear and equipment are to be available:<br>• Multimeter<br>• Lead acid battery<br>• Lithium battery<br>• Set of screwdrivers<br>• hydrometer<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench.<br>• Technical manuals | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | **Group activities** Engage the students in groups to practice battery data interpretation | • Calculate the cycle use of the battery<br>• Know DoD and SoC<br>• Count the number of cells<br>• Identify the type of batteries | | • The theoretical knowledge of how solar batteries store and supply electricity.<br>• Types of solar batteries and their differences.<br>• Application of each type of battery and the impacts of the environmental factors on the performance of solar batteries. | | |
| | | (c) Specifying solar charge controller | **Brainstorm** Guide students to outline devices that require charging and the effects of using incompatible chargers on devices, emphasizing potential damage and inefficiency.<br>**Practice** Provide the students with charge controllers to**:** | **The students should be able to explain how to:**<br>• Select tools and equipment required<br>• Interpret name plate data<br>• Read manufacturer's specification<br>• Calculate the current of the charge controller<br>• Connect the charge controller in the | Solar charge controller is specified as per manufacturer's specification | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to specify solar charge controller<br>**Principles:** The students should explain how to:<br>• Calculate Current carrying capacity of the device<br>• Convert voltage to current in MPPT charge controller<br>**Theories:** The | The following tools, safety gear and equipment are to be available:<br>• Multimeter<br>• Module<br>• Set of screw drivers<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Work bench. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | • Interpret nameplate information<br>• Identify types of charge controller<br>• Ways of connecting charge controllers | PV system<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | students should explain:<br>• Charge controller<br>• Types of charge controller<br>• Function of charge controller in the circuit | | |
| | | (d) Specifying a solar PV system inverter | **Datasheet Analysis:** Provide students with inverter datasheets from different manufacturers to interpret specifications and compare models.<br>**Visual Aids** Guide the students to visualize of installations various types of inverters types in solar PV systems.<br>**System Design activities** Guide students in selecting an | **The students should be able to explain how to:**<br>• Interpret nameplate data<br>• Read the manufacturer's specification<br>• Calculate the maximum input current<br>• Calculate the maximum output current<br>• Choose the type of inverter<br>• Observe safety precautions | Solar PV system inverter is specified as per the manufacturer's specification | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to specify solar PV system inverter<br>**Principles:** The students should explain the DC to AC conversion principle.<br>**Theories:** The students should explain:<br>• Inverter operation<br>• Types of inverters (standalone systems)<br>• Maximum operating power<br>• Function of inverter in the | The following tools, safety gear and equipment should be available:<br>• Multimeter<br>• Inverters<br>• Module<br>• Set of screwdrivers<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | appropriate inverter and justify their choice. | | | system | | |
| | 1.2 Performing solar PV basic measurement | (a) Performing solar cell voltage measurement | **Discussion**<br>Guide the students to discuss how voltage measurement applies to real-world scenarios, such as solar panel testing or system troubleshooting.<br><br>**Practice**<br>Provide students with a solar cell, multimeter, and solar simulator or sunlight to practice open circuit voltage measurement under different light intensities and temperatures. | **The students should be able to explain how to:**<br>• Select tools and equipment<br>• Measure the open circuit voltage of the cell<br>• Control temperature to maintain voltage constant<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | solar cell voltage measurement is performed as per manufacturer's specification | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to Perform solar cell voltage measurement<br>**Principles:** The students should state the basic principles of photovoltaic technology and the factors affecting voltage output.<br>**Theories:** The students should state their theoretical knowledge of how solar cells generate electricity. | The following tools, safety gear and equipment are to be available:<br>:<br>• Multimeter<br>• Monocrystalline PV Module<br>• Polycrystalline PV Module<br>• Amorphous PV Module<br>• Set of screwdrivers<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench. | 8 |
| | | (b) Performing PV module open circuit | **Discussion**<br>Guide the students to discuss how | **The students should be able to explain how to:** | PV module open circuit voltage | **Knowledge evidence: Detailed knowledge of:** | The following tools, safety gear and equipment are to be | |

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| | | voltage measurement | voltage measurement applies to real-world scenarios, such as solar panel testing or system troubleshooting.<br><br>**Practice**<br>Provide students with a solar panel, multimeter, and solar simulator or sunlight to practice open circuit voltage measurement under different light intensities and temperatures. | • Select tools and equipment<br>• Measure open circuit voltage<br>• Control temperature to maintain voltage constant<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | measurement is performed as per the manufacturer's specification | **Methods used**: The students should be able to explain how to perform PV module open circuit voltage measurement using appropriate tools and techniques.<br>**Principles:** The students should explain the steps of accurately measuring the open circuit voltage of PV modules.<br>**Theories:** The students should state the role of open circuit voltage measurement in monitoring their performance. | available:<br>• Multimeter<br>• Monocrystalline PV Module<br>• Polycrystalline PV Module<br>• Amorphous PV Module<br>• Set of screwdrivers<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench. | |
| | | (c) Performing PV module short-circuit current measurement | **Brainstorm**<br>Guide the students to discuss the effect of shade on the current generation<br>Provide students with a solar cell, multimeter, and solar simulator or sunlight to | **The students should be able to explain how to:**<br>• Select tools and equipment<br>• Measure short circuit current<br>• Compare the measured value with name plate value | PV module short-circuit current measurement is performed as per the manufacturer's specification | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to perform PV module short-circuit current measurement<br>• Prepare solar PV module. | The following safety equipment should be available:<br>• Multimeter<br>• Monocrystalline PV Module<br>• Polycrystalline PV Module<br>• Amorphous PV Module<br>• Set of screwdrivers | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | practice short-circuit current measurement under different light intensities and temperatures. | • Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | • Prepare measuring instrument<br>**Principles:** The students should explain the steps of accurately measuring the short-circuit current of PV modules<br>**Theories:** The students should explain the role of short-circuit current measurement. | • Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench. | |
| 2.0 Performing electrical joints | 2.1 Performing Cold Electrical Joints. | (a) Making eyelet joint. | **Brainstorming**<br>Guide the students in defining, identifying and describing the importance of choosing the right size and making eyelets<br>**Demonstration**<br>Show students steps by step of making eyelet joints<br>**Practical Activity**:<br>Provide students with a cable, eyelet terminals, and tools to practice making | **The students should be able to:**<br>• Select tools, equipment and materials required.<br>• Prepare cables for termination.<br>• Make cable joints.<br>• Test joints.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | The joint is made as per IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students would be able to explain how to make eyelet joint<br>**Method used:** The students should explain how to:<br>• Prepare cables for jointing.<br>• Execute particular joints<br>**Principles:** The students should explain how to make eyelet joint<br>**Theories:** The students should explain: | The following tools, equipment and safety gear are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench. | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | an eyelet cable joint. | | | • Properties of conductor materials<br>• Properties of insulator materials<br>• Factors determining strength of various joints<br>• Advantages of joints<br>• How to select the correct type of joint for a particular application | | |
| | | (b) Making crimp joint. | **Brainstorming**<br>Guide the students in defining, identifying and describing the importance of choosing the right size making crimp joint<br>**Demonstration**<br>Show students step-by-step steps by step of making crimp joints<br>**Practical Activity**:<br>Provide students with a cable, | **The students should be able to:**<br>• Select tools, equipment and materials required.<br>• Prepare cables for termination.<br>• Make cable joints.<br>• Test joints.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and | crimp joint is made as per IET regulation. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students would be able to explain how to make crimp joint<br>**Method used:** The students should explain how to:<br>• Prepare cables for jointing.<br>• Execute particular joints<br>**Principles:** The students should explain how to Make crimp joint. | The following tools, tools, equipment and safety gear are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Work bench. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | eyelet terminals, and tools to practice of making a crimp cable joint. | remaining materials. | | **Theories:** The students should explain:<br>• Making of crimp joint<br>• State IET regulations about crimp joint | | |
| | | (c) Making parallel groove clamp joint. | **Brainstorming**<br>Guide the students in defining, identifying and describing the importance of choosing the right size to make parallel groove clamp joint<br>**Demonstration**<br>Show students steps by step of making parallel groove clamp joint<br>**Practical Activity**:<br>Provide students with a cable, eyelet terminals, and tools to practice of making parallel groove joint. | **The students should be able to:**<br>• Select tools, equipment and materials required.<br>• Prepare cables for termination.<br>• Make cable joints.<br>• Test joints.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remained materials. | Parallel groove clamp joint is made as per IET regulation. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to make parallel groove clamp joint.<br>**Method used:** The students should explain how to:<br>• Prepare cables for jointing.<br>• Execute particular joints<br>**Principles:** The students should explain how to Make parallel groove clamp joint.<br>**Theory:** the students should explain how to:<br>• Make parallel groove clamp joint<br>• IET regulation | The following tools, tools, equipment and safety gear are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Work bench. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | about Making parallel groove clamp joint | | |
| | | (d) Making bolt joint. | **Brainstorming** Guide the students in defining, identifying and describing the importance of choosing the right size making bolt joint **Demonstration** Show students steps by step of making bolt joints **Practical Activity**: Provide students with a cable, eyelet terminals, and tools to practice of making bolt cable joint. | **The students should be able to:** • Select tools, equipment and materials required. • Prepare cables for termination. • Make cable joints. • Test joints. • Observe safety precautions • Clean work area. • Store tools, equipment and remained materials. | Bolt joint is made as per IET regulation. | **Knowledge evidence: Detailed knowledge of:** **Methods used**: The students would be able to explain how to: Make bolt joint. **Method used:** The students should explain how to: • Prepare cables for jointing. • Execute particular joints **Principles:** The students should explain how to Making bolt joint. **Theory:** the students should explain how to: • Make bolt joint • IET regulation about Making Make bolt joint | The following tools, tools, equipment and safety gear are to be available: • Diagonal cutting pliers. • Combination pliers. • Electrician knife. • Measuring tape. • Long nose pliers. • multimeter. • Safety goggles. • Safety boots. • Overall. • Work bench. | |
| | | (e) Making twist joint. | **Brainstorming** Guide the students in defining, identifying and describing the importance of choosing the right | **The students should be able to:** • Select tools, equipment and materials required. • Prepare cables | Twist joint is made as per IET regulation. | **Knowledge evidence: Detailed knowledge of:** **Methods used**: The students would be able to explain how to: make twist joint | The following tools, tools, equipment and safety gear are to be available: • Diagonal cutting pliers. • Combination | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | size making twist joint<br>**Demonstration**<br>Show students step-by-step making twist joints<br>**Practical Activity**:<br>Provide students with a cable, eyelet terminals, and tools to practice of making twist cable joints. | for termination.<br>• Make cable joints.<br>• Test joints.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | **Method used:** The students should explain how to:<br>• Prepare cables for jointing.<br>• Execute particular joints<br>**Principles:** The students should explain how to make a twist joint.<br>**Theory:** the students should explain how to: make twist joint as per IET regulation. | pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench. | |
| | | (f) Making Tee joint. | **Brainstorming**<br>Guide the students in defining, identifying and describing the importance of choosing the right size making tee joint<br>**Demonstration**<br>Show students step-by-step steps by step of making tee joints<br>**Practical Activity**: | **The students should be able to:**<br>• Select tools, equipment and materials required.<br>• Prepare cables for termination.<br>• Make cable joints.<br>• Test joints.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, | Tee joint is made as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students would be able to explain how to Make Tee joint<br>**Principles:** The students should explain the importance of precision and accuracy in creating Tee joints<br><br>**Theory:** the students should explain: | The following tools, tools, equipment and safety gear are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• multimeter<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | Provide students with a cable, eyelet terminals, and tools to practice making tee cable joints. | equipment and remaining materials. | | • Make Tee joint<br>• Types of Tee joints and their applications. | | |
| | | (g) Making married joint. | **Brainstorming**<br>Guide the students in defining, identifying and describing the importance of choosing the right size making married joint<br>**Demonstration**<br>Show students step-by-step making married joints<br>**Practical Activity**:<br>Provide students with a cable, eyelet terminals, and tools to practice making married cable joints. | **The students should be able to:**<br>• Select tools, equipment and materials required.<br>• Prepare cables for termination.<br>• Make cable joints.<br>• Test joints.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | The married joint is made as per IET regulation. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students would be able to explain how to make married joint<br><br>**Principles:** The students should state procedures for making married joint<br><br>**Theory:** The students should state<br>• What is a Married joint<br>• The applications for married joint | The following tools, tools, equipment and safety gear are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Workbench. | |
| | 2.2 Performing | (a) Carrying | **Discussion** | **The students** | soft soldering | **Knowledge evidence:** | The following tools, | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | soldering | out soft soldering. | Guide the students to discuss soft soldering as applied in the field of engineering to join wire/metal<br>**Demonstration**<br>Show students step-by-step how to do soft soldering<br>**Guided Practice**<br>Provide students with wires, resistors and small circuit boards to guide them through the soft soldering process | **should be able to:**<br>• Interpret the diagram.<br>• Identify tools, safety gear, equipment and material required.<br>• Prepare the parts to be soldered.<br>• Heat the surface thoroughly.<br>• Solder the parts.<br>• Remove surplus solder using a wire brush.<br>• Safety precautions.<br>• Clean the work area.<br>• Store tools, safety gear, equipment and remaining materials. | is carried out as per IET regulation | **Detailed knowledge of:**<br>**Methods used**: The students should explain how to carry out soft soldering<br>**Principles:** The students should explain how to perform soft soldering.<br>**Theories:** The students should explain:<br>• The conversion of electrical energy into heat energy.<br>• Types of soldering materials.<br>• Application of soldering.<br>• The uses of various tools and equipment. | tools, equipment and safety gear are to be available:<br>• Soldering iron.<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Pot and ladle.<br>• Electrician knife.<br>• Long nose pliers.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overoll.<br>• Safety gloves. | |
| | | (b) Carrying out hard soldering. | **Discussion**<br>Guide the students to discuss hard | **The students should be able to:**<br>• Interpret the | Hard soldering is carried out as per IET regulation | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The | The following tools, equipment and safety gear are to be available: | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | soldering as applied in the field of engineering to join wire/metal<br>**Demonstration**<br>Show students step by step how to do hard soldering<br>**Guided Practice**<br>Provide students with wires, resistors and small circuit boards to guide them in the hard soldering process | diagram.<br>• Identify tools, safety gear, equipment and material required.<br>• Prepare the parts to be soldered.<br>• Heat the surface thoroughly.<br>• Solder the parts.<br>• Remove surplus solder using a wire brush.<br>• Observe safety precautions.<br>• Clean the work area.<br>• Store tools, safety gear, equipment and remaining materials. | | students should explain how to carry out hard soldering.<br>**Principles:** The students should explain how to perform hard soldering.<br>**Theories:** The students should explain how to:<br>• Perform hard soldering<br>• IET regulation regarding hard soldering | equipment should be available:<br>• Soldering iron.<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Blow lamp.<br>• Soldering stand.<br>• Adjustable third hand with magnifying glass<br>• Soldering sucker.<br>• Soldering gun.<br>• Electrician knife.<br>• Long nose pliers.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Safety gloves. | |
| 3.0 Building simple dc circuits | 3.1 Constructing resistive circuits | (a) Buildinga single resistor circuit. | **Brainstorm**<br>Guide the students to discuss the importance of resistive circuits in electrical | **The students should be able to:**<br>• Design a circuit diagram of the resistive circuit. | The single resistor circuit is constructed as per IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a single resistor circuit | The following tools, tools, equipment and safety gear are to be available:<br>• Workbench.<br>• Electronics board. | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | engineering and daily life.<br><br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualizing the connection of resistor<br><br>**Practice**<br>Provide students with connecting wire, resistor, and multimeter to practice single resistor circuits. | • Select equipment, tools and material required.<br>• Prepare resistor and cables for termination.<br>• Build a single resistor circuit.<br>• Solder the built circuits.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remaining materials. | | **Principles:** The students should explain how to:<br>• Construct resistor circuits.<br>• Carry out measurements in resistor circuits.<br>**Theories:** The students should explain:<br>• Ohms' Law and its applications<br>• Types of electrical materials.<br>• The uses of various tools and equipment.<br>• Electrical symbols used for resistor. | • Soldering iron/gun.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles. | |
| | | (b) Building series resistive circuit. | **Brainstorm**<br>Guide the students to discuss the importance of series resistive circuits in electrical engineering and daily life.<br><br>**Visual Aids** | **The students should be able to:**<br>• Design a circuit diagram of the resistive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare | The series resistive circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a series of resistive circuits.<br>**Principles:** The students should explain how to:<br>• Construct series | The following tools, tools, equipment and safety gear are to be available:<br>• Workbench.<br>• Electronics board.<br>• Soldering iron/gun.<br>• Electrician knife.<br>• Combination pliers. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | Guide the students to use interactive circuit simulators to visualizing the connection of series resistive circuit<br><br>**Practice**<br>Provide students with connecting wire, resistors, and multimeter to practice parallel resistor circuit. | resistors and cables for termination.<br>• Build a series resistive circuit.<br>• Solder the built circuits.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remained materials. | | resistive circuit.<br>• Carry out measurements in series resistive circuits.<br>**Theories:** The students should explain how to:<br>• Connect resistors in series<br>• Calculate total resistance<br>• Calculate circuit current | • Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles. | |
| | | (c) Building parallel resistive circuit. | **Brainstorm**<br>Guide the students to discuss the importance of parallel resistive circuits in electrical engineering and daily life.<br><br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of | **The students should be able to:**<br>• Design a circuit diagram of the resistive circuit.<br>• Select tools equipment and material required.<br>• Prepare resistors and cables for termination.<br>• Build a parallel resistive circuit. | The parallel resistive circuit is built as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a parallel resistive circuit.<br>**Principles:** The students should explain how to:<br>• Construct parallel resistive circuits.<br>• Carry out measurements in parallel resistive circuits. | The following tools, tools, equipment and safety gear are to be available:<br>• Workbench.<br>• Electronics board.<br>• Soldering iron/gun.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | parallel resistive circuit<br><br>**Practice**<br>Provide students with connecting wire, resistors, and multimeter to practice parallel resistive circuit. | • Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remained materials. | | **Theories:** The students should explain how to:<br>• Connect resistors in parallel<br>• Calculate total resistance<br>• Calculate current and voltage in parallel circuit | • Overall.<br>• Safety goggles. | |
| | | (d) Building series – parallel resistive circuit | **Brainstorm**<br>Guide the students to discuss the importance of series -parallel resistive circuits in electrical engineering and daily life.<br><br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of series-parallel resistive circuit<br><br>**Practice**<br>Provide students with connecting wires, resistors, | **The students should be able to:**<br>• Design a circuit diagram of the series-parallel resistive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare resistors and cables for termination.<br>• Build series-parallel resistive circuit<br>• Observe safety precautions.<br>• Clean work area, tools and | The series – parallel resistive circuit is built as per IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how **to** build series – parallel resistive circuits.<br>**Principles:** The students should explain how to:<br>• Construct series-parallel resistive circuit circuits.<br>• Carry out measurements in resistor circuits.<br>**Theories:** The students should explain how to:<br>• Connect series-parallel resistive circuit | The following tools, tools, equipment and safety gear are to be available:<br>• Work bench.<br>• Electronics board.<br>• Soldering iron/gun.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | and multimeters to practice series-parallel resistive circuits. | equipment.<br>• Store tools, equipment and remaining materials. | | • Calculate total resistance<br>• Calculate current and voltage in the circuit | | |
| | 3.2 construct capacitive circuits | (a) Building a single capacitor circuit. | **Brainstorm**<br>Guide the students to discuss the importance of single capacitive circuits in electrical engineering and daily life.<br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of the single capacitive circuit<br>**Practice**<br>Provide students with connecting wire, capacitor, and multimeter to practice capacitive circuits. | **The students should be able to:**<br>• Design a circuit diagram of the capacitive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare capacitor and cables for termination.<br>• Build a single capacitor circuit.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remaining materials. | The single capacitive circuit is built as per IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a single capacitor circuit<br>**Principles:** The students should explain how to:<br>• Construct single capacitive circuits.<br>• Carry out measurements in the capacitor.<br>**Theories:** The students should explain:<br>• Types of capacitors<br>• Application of capacitors<br>• Electrical symbols used to construct the capacitive circuit.<br>• Calculation of capacitive reactance | The following tools, tools, equipment and safety gear are to be available:<br>• Work bench.<br>• Electronics board.<br>• Soldering iron/gun.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles. | 8 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | • Calculation of voltage and current in the circuit | | |
| | | (b) Building a series capacitive circuit. | **Brainstorm**<br>Guide the students to discuss the importance of series capacitive circuits in electrical engineering and daily life.<br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of series of capacitive circuit<br>**Practice**<br>Provide students with connecting wire, capacitors, and multimeter to practice series capacitive circuit. | **The students should be able to:**<br>• Design a circuit diagram of the capacitive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare capacitors and cables for termination.<br>• Build a series capacitive circuit.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remained materials. | The series capacitive circuit is built as per IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a series of capacitive<br>**Principles:** The students should explain how to:<br>• Construct series capacitive circuits.<br>• Carry out measurements in series capacitive circuits.<br>**Theories:** The students should explain:<br>• Connection of series capacitive circuit<br>• Calculation of total capacitance of capacitors in the circuit<br>• Calculation of capacitive reactance<br>• Calculation of | The following tools, safety gear and equipment should be available:<br>• Work bench.<br>• Electronics board.<br>• Soldering iron/gun.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | voltage and current in the circuit | | |
| | | (c) Building parallel capacitive circuits. | **Brainstorm**<br>Guide the students to discuss the importance of parallel capacitive circuits in electrical engineering and daily life.<br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of parallel capacitive circuit<br>**Practice**<br>Provide students with connecting wires, capacitors, and multimeters to practice parallel capacitive circuits. | **The students should be able to:**<br>• Design a circuit diagram of the capacitive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare capacitors and cables for termination.<br>• Build a parallel capacitive circuit.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remaining materials. | The parallel capacitive circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a parallel capacitive circuit.<br>**Principles:** The students should explain how:<br>• Construct parallel capacitive circuits.<br>• Carry out measurements in parallel capacitor circuits.<br>**Theories:** The students should explain:<br>• Connection of parallel capacitive circuit<br>• Calculation of total capacitance<br>• Calculation of capacitive reactance<br>• Calculation of voltage and current in a | The following tools, safety gear and equipment should be available:<br>• Work bench.<br>• Electronics board.<br>• Soldering iron/gun.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | parallel capacitive circuit | | |
| | | (d) Building series – parallel capacitive circuit. | **Brainstorm**<br>Guide the students to discuss the importance of series-parallel capacitive circuits in electrical engineering and daily life.<br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of series-parallel capacitive circuit<br>**Practice**<br>Provide students with connecting wires, capacitors, and multimeters to practice series–parallel capacitive circuits. | **The students should be able to:**<br>• Design a circuit diagram of the capacitive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare capacitors and cables for termination.<br>• Build a combination of capacitive circuits.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remaining materials. | The series-parallel capacitive circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a series – of parallel capacitive circuits<br>**Principles:** The students should explain how to:<br>• Construct series-parallel capacitive circuits.<br>• Carry out measurements in series-parallel capacitor circuits.<br>**Theories:** The students should explain:<br>• Connection of series-parallel capacitive circuit<br>• Calculation of total capacitance of the capacitors<br>• Calculation of capacitive reactance<br>• Calculation of voltage and | The following tools, safety gear and equipment are to be available:<br>• Work bench.<br>• Electronics board.<br>• Soldering iron/gun.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | current in a series-parallel capacitive circuit | | |
| | 3.3 Constructing inductive circuits | (a) Building a single inductive circuit. | **Brainstorm**<br>Guide the students to discuss the importance of single inductive circuit circuits in electrical engineering and daily life.<br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of the single inductive circuit<br>**Practice**<br>Provide students with connecting wire, inductor, and multimeter to practice single inductive circuits. | **The students should be able to:**<br>• Design a circuit diagram of the inductive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare inductors and cables for termination.<br>• Build a single inductor circuit.<br>• Measure and record the inductive parameters of the circuits.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remainders. | The inductive circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a single inductive circuit<br>**Principles:** The students should explain how to:<br>• Construct inductive circuits.<br>• Carry out measurement in an inductive circuit.<br>**Theories:** The students should explain:<br>• Operation of inductor<br>• Connection of single inductive circuit<br>• Calculation of inductive reactance<br>• Calculation of voltage and current in a single | The following tools, safety gear and equipment are to be available:<br>• Electronics board.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overalls.<br>• Safety goggles.<br>• Workbench.<br>• Safety boot. | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | inductive circuit | | |
| | | (b) Building a series inductive circuit | **Brainstorm**<br>Guide the students to discuss the importance of series inductive circuit circuits in electrical engineering and daily life.<br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of a series of inductive circuit<br>**Practice**<br>Provide students with connecting wires, inductors, and multimeters to practice series inductive circuit. | **The students should be able to:**<br>• Design a circuit diagram of the inductive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare inductors and cables for termination.<br>• Build a two-inductor circuit in series.<br>• Solder the built circuits.<br>• Measure and record the inductive parameters of the circuits.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remainders. | The series inductive circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a series inductive circuit<br>**Principles:** The students should explain how to:<br>• Construct a series inductive circuit.<br>• Carry out measurement in an inductive circuit.<br>**Theories:** The students should explain:<br>• Connection of series inductive circuit<br>• Calculation of inductance in a series inductive circuit<br>• Calculation of inductive reactance in series inductive circuit<br>• Calculation of voltage and | The following tools, safety gear and equipment are to be available:<br>• Electronics board.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• Analogue and digital multimeter.<br>• Measuring tape.<br>• Overalls.<br>• Safety goggles.<br>• Work bench.<br>• Safety boot. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | current in a series inductive circuit | | |
| | | (c) Building a parallel inductive circuit. | **Brainstorm**<br>Guide the students to discuss the importance of parallel inductive circuit circuits in electrical engineering and daily life.<br><br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of parallel inductive circuit<br><br>**Practice**<br>Provide students with connecting wires, inductors, and multimeters to practice parallel inductive circuits. | **The students should be able to:**<br>• Design a circuit diagram of the inductive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare inductors and cables for termination.<br>• Build a parallel inductive circuit.<br>• Solder the built circuits.<br>• Measure and record the inductive parameters of the circuits.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remainders. | Parallel Inductive circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build parallel inductive circuit.<br>**Principles:** The students should explain how to:<br>• Construct parallel inductive circuits.<br>• Carry out measurement in an inductive circuit.<br><br>**Theories:** The students should explain:<br>• Connection of parallel inductive circuit<br>• Calculation of total inductance of the inductor<br>• Calculation of inductive reactance<br>• Calculation of | The following tools, safety gear and equipment are to be available:<br>• Electronics board.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• Analogue and digital multimeter.<br>• Measuring tape.<br>• Overalls.<br>• Safety goggles.<br>• Work bench.<br>• Safety boot. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | voltage and current | | |
| | | (d) Building series parallel inductive circuit. | **Brainstorm**<br>Guide the students to discuss the importance of series-parallel inductive circuit circuits in electrical engineering and daily life.<br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of series-parallel inductive circuit<br>**Practice**<br>Provide students with connecting wires, inductors, and multimeters to practice series-parallel inductive circuits. | **The students should be able to:**<br>• Design a circuit diagram of the inductive circuit.<br>• Select tools, equipment and materials required.<br>• Prepare inductors and cables for termination.<br>• Build a combination circuit.<br>• Solder the built circuits.<br>• Measure and record the inductive parameters of the circuits.<br>• Observe safety precautions.<br>• Clean work area, tools and equipment.<br>• Store tools, equipment and remainders. | Series parallel inductive circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build series parallel inductive circuit<br>**Principles:** The students should explain how to:<br>• Construct series – parallel inductive circuits.<br>• Carry out measurement in an inductive circuit.<br>**Theories:** The students should explain:<br>• Connection of series-parallel inductive circuit<br>• Calculation of total inductance<br>• Calculation of inductive reactance<br>• Calculation of voltage and | The following tools, safety gear and equipment are to be available:<br>• Electronics board.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• Analogue and digital multimeter.<br>• Measuring tape.<br>• Overalls.<br>• Safety goggles.<br>• Workbench.<br>• Safety boot. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | current | | |
| | 3.4 Constructing RLC circuit | (a) Building a resistor and capacitor (RC) circuit. | **Brainstorm**<br>Guide the students to discuss the importance of resistive and capacitive circuit circuits in electrical engineering and daily life.<br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection between the resistive and capacitive circuit<br>**Practice**<br>Provide students with connecting wires, inductors, capacitors and multimeters to practice resistive capacitive circuits. | **The students should be able to:**<br>• Design a wiring diagram of the RC circuit.<br>• Select tools, equipment and materials required.<br>• Prepare resistor, capacitors and cable for termination.<br>• Build RC circuit.<br>• Solder the built circuits.<br>• Measure and record the RC parameters of the circuit.<br>• Observe safety precautions.<br>• Clean the work area, tools and equipment.<br>• Store tools, equipment and the remaining materials. | The resistor and capacitor (RC) circuit is made as per IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a resistor and capacitor (RC) circuit.<br>**Principles:** The students should explain how to:<br>• Construct RC circuit.<br>• Carry out measurements in an RC circuit.<br>**Theories:** The students should explain:<br>• Connection of RC circuit<br>• Calculation of impedance of the circuit<br>• Calculation of voltage and current | The following tools, safety gear and equipment are to be available:<br>• Electrician board.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles.<br>• Workbench.<br>• Safety boot. | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | (b) Building a resistor and inductor (RL) circuit. | **Brainstorm**<br>Guide the students to discuss the importance of resistive and inductive circuit circuits in electrical engineering and daily life.<br><br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection between resistive and inductive circuit<br><br>**Practice**<br>Provide students with connecting wires, inductors, capacitors and multimeters to practice resistive inductive circuits. | **The students should be able to:**<br>• Design a wiring diagram of the RL circuit.<br>• Select tools, equipment and materials required.<br>• Prepare inductors, resistor and cable for termination.<br>• Build RL circuit.<br>• Solder the built circuits.<br>• Measure and record the RL parameters of the circuit.<br>• Observe safety precautions.<br>• Clean the work area, tools and equipment.<br>• Store tools, equipment and the remaining materials. | The resistor and inductor (RL) circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build a resistor and inductor (RL) circuit<br>**Principles:** The students should explain how to:<br>• Construct RL circuit.<br>• Carry out measurements in an RL circuit.<br>**Theories:** The students should explain:<br>• Connection of RL circuit<br>• Calculation of impedance<br>• Calculation of voltage and current | The following tools, safety gear and equipment are to be available:<br>• Electrician board.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• Analogue and digital multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles.<br>• Workbench.<br>• Safety boot. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | (c) Building a resistor, capacitor and inductor (RLC) circuit. | **Brainstorm**<br>Guide the students in defining, identifying and describing the importance of resistive and capacitive circuit circuits in electrical engineering and daily life.<br><br>**Visual Aids**<br>Guide the students to use interactive circuit simulators to visualise the connection of resistive, inductive and capacitive circuit<br><br>**Practice**<br>Provide students with connecting wires, inductors, capacitors, capacitors and multimeters to practice resistive, inductive capacitive | **The students should be able to:**<br>• Design a wiring diagram of the RLC circuit.<br>• Select tools, equipment and material required.<br>• Prepare inductors, capacitors, resistor and cable for termination.<br>• Build RLC circuit.<br>• Measure and record the RLC parameters of the circuit.<br>• Observe safety precautions.<br>• Clean the work area, tools and equipment.<br>• Store tools, equipment and the remaining materials. | Resistor, capacitor and inductor (RLC) circuit is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to build resistor, capacitor and inductor (RLC) circuit.<br>**Principles:** The students should explain how to:<br>• Construct RLC circuit.<br>• Carry out measurement in an RLC circuit.<br>**Theories:** The students should explain:<br>• Connection of RLC circuit<br>• Calculation of circuit impedance<br>• Calculation of voltage and current | The following tools, safety gear and equipment are to be available:<br>• Electrician board.<br>• Electrician knife.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Long nose pliers.<br>• multimeter.<br>• Measuring tape.<br>• Overall.<br>• Safety goggles.<br>• Work bench.<br>• Safety boot. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | circuits. | | | | | |
| | 3.5 MeasuringElectric Quantities | (a) Measuring voltage in the circuit. | **Discussion**<br>Guide students to discuss the term voltage by using common examples such as water in the pipe, water in a river<br>**Visual Aids**<br>Guide the students to visualize how voltage behaves in the circuit.<br>**Show** students the steps of building a simple circuit for measuring voltage<br><br>**Practice**<br>Provide students with materials, components and measuring instruments to build simple series / parallel circuits with resistors and a voltage source for measuring of voltage. | **The students should be able to:**<br>• Select tools and equipment<br>• Determine component values.<br>• Connect simple electric circuits.<br>• Measure voltage.<br>• Observe safety precautions.<br>• Clean workplace.<br>• Store tools and equipment. | voltage in a circuit is measured as per IET regulation | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to measure voltage in the circuit.<br>**Principles:** The students should explain how to: measure voltage in the circuit<br>**Theories:** The students should explain:<br>• Ohm's law.<br>• Voltmeter operation<br>• Scale extension of voltmeter scale<br>• Connection of voltmeter<br>• Range selection | The following tools, safety gear and equipment are to be available:<br>• Electrical components.<br>• Multimeters.<br>• Tool kit.<br>• Workbench.<br>• Power supply.<br>• Safety boots.<br>• Plastic gloves.<br>• Overall. | 8 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | (b) Measuring current in the circuit. | **Discussion**<br>Guide students to discuss the term current by using common examples such as water in the pipe, water in a river<br>**Visual Aids**<br>Guide the students to visualize how current behaves in the circuit.<br>**Demonstration**<br>Show students steps of building a simple circuit for measuring current<br><br>**Practice**<br>Provide students with materials, components and measuring instruments to build simple series / parallel circuits with resistors and a voltage source for measuring current. | **The students should be able to:**<br>• Select tools and equipment<br>• Determine component values.<br>• Connect simple electric circuits.<br>• Measure electric current.<br>• Observe safety precautions.<br>• Clean workplace.<br>• Store tools and equipment. | The electric current in a circuit is measured as per IET regulation | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**:<br>The students should explain how to measure electric current in a circuit<br>**Principles:** The students should follow procedures on how to measure electric current in a circuit<br>**Theories:** The students should explain:<br>• Operation of an Ammeter<br>• Scale extension of the Ammeter<br>• Connection of an ammeter in the circuit<br>• Range selection | The following tools, safety gear and equipment are to be available:<br>• Electrical components.<br>• Multimeters.<br>• Tool kit.<br>• Workbench.<br>• Power supply.<br>• Safety boots.<br>• Plastic gloves.<br>• Overall. | |
| | | (c) Measuring | **Discussion** | **The students** | The resistance | **Knowledge evidence:** | The following tools, | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | resistance in the circuit | Guide students to discuss the term resistance by using common examples such as water in the pipe, water in a river<br>**Visual Aids**<br>Guide the students to visualize how resistance behaves in the circuit.<br>**Show** students steps of building a simple circuit for measuring resistance<br><br>**Practice**<br>Provide students with materials, components and measuring instruments to build simple series / parallel circuits with resistors and a voltage source for measuring resistance. | **should be able to:**<br>• Select tools, equipment and materials<br>• Determine component values.<br>• Connect simple electric circuits.<br>• Measure resistance.<br>• Observe safety precautions.<br>• Clean workplace.<br>• Store tools and equipment. | of the resistor in a circuit is measured as per IET regulation. | **Detailed knowledge of:**<br>**Methods used**:<br>The students should explain **how to** measure the resistance of the resistor in a circuit.<br>**Principles:** The students should explain how to:<br>• Operate an ohmmeter to measure resistance<br>• Measure resistance.<br>**Theories:** The students should explain:<br>• Operation of an ohmmeter<br>• Connection of an ohmmeter in the circuit<br>• Selection range | The following tools, safety gear and equipment are to be available:<br>• Electrical components.<br>• Multimeters.<br>• Tool kit.<br>• Workbench.<br>• Power supply.<br>• Safety boots.<br>• Plastic gloves.<br>• Overall. | |
| | 3.6 Determining characteristic | (a) Testing characteristi | **Discussion**<br>Guide the students | **The students should be able to:** | Characteristics of diodes is | **Knowledge evidence:**<br>**Detailed knowledge** | The following tools, safety gear and | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | s of active electronic components | cs of diodes | to discuss the role of diodes in electronic circuits, highlighting their importance in power supplies and signal processing.<br>**Demonstration**<br>Show students how to use a digital multimeter to test characteristics of diodes (forward and reverse bias)<br>**Practice**<br>Provide students with a variety of diodes to test the characteristics | • Select tools, equipment, safety gear and components<br>• Construct circuit<br>• Connect test equipment<br>• Perform component characteristics test<br>• Record test results<br>• Observe safety measures<br>• Clean workplace<br>• Store tools, equipment, safety gear and components | tested as per IET regulation | **of:**<br>**Methods used**:<br>The students should explain how to test the characteristics of diodes<br>**Principles:** The students should explain how to:<br>• Construct the diode.<br>• Carry out measurement<br>**Theories:** The students should explain: -<br>• Semiconductor theory<br>• The PN junction<br>• Types of diode<br>• Terminal identification<br>• Application of the diode | equipment are to be available:<br>• Electronic components.<br>• Signal generator.<br>• multimeters.<br>• Electronics technician's tool kit.<br>• Workbench.<br>• Oscilloscope.<br>• Power supply.<br>• Safety boots<br>• Gloves<br>• Safety goggles<br>• overalls | |
| | | (b) Testing characteristics of transistors | **Discussion**<br>Guide the students to discuss the role of transistors in electronic circuits, highlighting their importance in switching and signal processing.<br>**Demonstration** | **The students should be able to:**<br>• Select tools, equipment, safety gear and components<br>• Construct circuit<br>• Connect test | characteristics of transistors are tested as per IET regulation | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**:<br>The students should explain how to test the characteristics of transistors<br>**Principles:** The students should | The following tools, safety gear and equipment are to be available:<br>• Electronic components.<br>• Signal generator.<br>• Analog and digital multimeters. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | Show students how to use a digital multimeter to test the characteristics of transistor configuration<br>**Practice**<br>Provide students with a transistor to test its characteristics | equipment<br>• Perform component characteristics test<br>• Record test results<br>• Observe safety measures<br>• Clean workplace<br>• Store tools, equipment, safety gear and components | | explain how to:<br>• Construct the transistor.<br>• Carry out measurement<br>**Theories:** The students should explain: -<br>• The PNP/NPN formation<br>• Terminal identification<br>• Biasing of the transistor<br>• Application of the transistor | • Electronics technician's tool kit.<br>• Workbench.<br>• Workbench light.<br>• Oscilloscope.<br>• Power supply.<br>• Safety boots<br>• Helmets<br>• Gloves<br>• Safety goggles<br>• overalls | |
| | | (c) Testing characteristics of thyristor | **Discussion**<br>Guide the students to discuss the role of Thyristors in electronic circuits, highlighting their importance in power supplies and signal processing.<br>**Demonstration**<br>Show students how to use a digital multimeter to test the characteristics of the Thyristor (forward and | **The students should be able to:**<br>• Select tools, equipment, safety gear and components<br>• Construct circuit<br>• Perform component characteristics test<br>• Record test results<br>• Observe safety measures<br>• Clean | The characteristic of thyristor is tested as per IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**:<br>The students should explain how to test the characteristics of thyristor<br>**Principles:** The students should explain the principles of:<br>• Construct the thyristor.<br>• Carry out measurement<br>**Theories**: The students should explain: - | The following tools, safety gear and equipment are to be available:<br>-<br>• Electronic components.<br>• Signal generator.<br>• multimeters.<br>• Electronics technician's tool kit.<br>• Workbench.<br>• Oscilloscope.<br>• Power supply.<br>• Safety boots<br>• Helmets | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | reverse bias)<br>**Practice**<br>Provide students with a variety of Thyristor to test their characteristics | workplace<br>• Store tools, equipment, safety gear and components | | • Construction of thyristor<br>• Terminal identification<br>• Thyristor as the controlled rectifier | • Gloves<br>• Safety goggles<br>• overalls | |
| | 3.7 Constructing rectifier circuits | (a) Building half-wave rectifier | **Discussion**<br>Guide the students to discuss the half-wave rectifiers and their practical applications in power supplies<br>**Demonstration**<br>Show students how to build half-wave rectifier circuits on a breadboard and test their functions.<br>**Practice**<br>Provide students with a diode, transformer, multimeter, capacitor, and breadboard to practice half-wave rectifier circuit | **The students should be able to:**<br>• Select tools, equipment, components and safety gear<br>• Construct a wave rectifier circuit<br>• Test constructed circuit<br>• Record test results<br>• Observe safety<br>• Clean workplace<br>• Store tools, equipment, components and safety gear. | Constructed rectifier circuit functions as per IET regulation. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**:<br>The students should explain how to build a half-wave rectifier<br>**Principles:** The students should explain how to build a half-wave rectifier<br>**Theories:** The students should explain: -<br>• Connection of half wave rectifier<br>• Operation of half-wave rectifier<br>• Smoothing capacitor<br>• Ripple voltage<br>• Voltage regulator | The following tools, safety gear and equipment are to be available:<br>• Electronic components.<br>• multimeters.<br>• Electronics technician's tool kit.<br>• Workbench.<br>• Oscilloscope.<br>• Power supply.<br>• Safety boots<br>• Gloves<br>• Safety goggles<br>• overalls | 24 |
| | | (b) Building full-wave | **Discussion**<br>Guide the students | **The students should be able to:** | Full-wave rectifier | **Knowledge evidence:**<br>**Detailed knowledge** | The following tools, safety gear and | |

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| | | rectifier (center tapped) | to discuss the full wave (centre tapped) rectifiers and its practical applications in power supplies **Demonstration** Show students how to build full wave (centre tapped) rectifier circuits on a breadboard and test its functions. **Practice** Provide students with diode, transformer, multimeter, capacitor, and breadboard to practice full wave (centre tapped) rectifier circuit | • Select tools, equipment, components and safety gear<br>• Construct centre tapped full wave rectifier circuit<br>• Test the circuit<br>• Record test results<br>• Observe safety<br>• Clean workplace<br>• Store tools, equipment, components and safety gear. | (centre-tapped) rectifier is built as per IET regulation | **of:** **Methods used**: The students should explain how to build full-wave rectifier (center tapped) rectifier **Principles:** The students should explain how to build full-wave rectifier (center tapped) rectifier **Theories:** The students should explain: -<br>• Connection of full wave (center taped) rectifier<br>• Operation of full wave rectifier<br>• Smoothing capacitor in full wave rectifier<br>• Ripple voltage in full wave rectifier<br>• Voltage regulator of full wave rectifier | equipment are to be available:<br>• Electronic components.<br>• multimeter.<br>• Electronics technician's tool kit.<br>• Work bench.<br>• Oscilloscope.<br>• Power supply.<br>• Safety boots<br>• Gloves<br>• Safety goggles<br>• overalls | |
| | | (c) Building bridge rectifier | **Discussion** Guide the students to discuss the bridge rectifiers and their practical applications in | **The students should be able to:**<br>• Select tools, equipment, components and safety gear | the bridge rectifier is built as per IET regulation | **Knowledge evidence: Detailed knowledge of:** **Methods used**: The students should explain how to build a | The following tools, safety gear and equipment are to be available:<br>• Electronic components. | |

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| | | | power supplies<br>**Demonstration**<br>Show students how to build bridge rectifier circuits on a breadboard and test its functions.<br>**Practice**<br>Provide students with a diode, transformer, multimeter, capacitor, and breadboard to practice bridge rectifier circuit | • Construct bridge rectifier circuit<br>• Test the circuit<br>• Record test results<br>• Observe safety<br>• Clean workplace<br>• Store tools, equipment, components and safety gear. | | bridge rectifier<br>build bridge rectifier<br>**Principles:** The students should explain how to build bridge rectifier<br>**Theories:** The students should explain: -<br>• Connection of bridge rectifier<br>• Operation of bridge rectifier<br>• Smoothing capacitor in bridge rectifier<br>• Ripple voltage in bridge rectifier<br>• Voltage regulator of bridge rectifier | • multimeter.<br>• Electronics technician's tool kit.<br>• Workbench.<br>• Oscilloscope.<br>• Power supply.<br>• Safety boots<br>• Helmets<br>• Gloves<br>• Safety goggles<br>• overalls | |
| 4.0 Performing basic electrical installation | 4.1 Installing lighting circuits | (a) Iinstalling lighting pointscontrolled by one way one gang switch. | **Brainstorm**<br>Guide the students to discuss the purpose of a lighting circuit and its role in household or commercial electrical systems.<br>**Circuit Drawing:**<br>Guide students to draw the layout of a typical lighting | **The students should be able to:**<br>• Prepare electrical drawings.<br>• Select tools, equipment and materials required.<br>• Prepare accessories and cables for lighting circuits. | lighting points controlled by one way one gang switch is Installed as per IET regulation | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to install lighting points controlled by one way one gang switch<br>**Principles:** The students should explain how to<br>• Lay cable with non-corrosive | The following tools, safety gear and equipment are to be available:<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Claw hammer.<br>• Set of screw | 32 |

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| | | | circuit,<br>**Demonstration:** Show students how to connect the circuit accessories<br>**Practice**<br>Provide students with the components (switch, light fixture, wiring) and guide them through installing a basic single-pole lighting circuit. | • Install lighting circuit.<br>• Test the installation.<br>• Apply safety measures.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | materials<br>• Calculate the resistance of the wire<br>**Theories:** The students should explain:<br>• Different types of wire<br>• Wire colour codes<br>• Types of lamps and their applications<br>• Installation diagram<br>• Circuit diagram<br>• Wiring diagram | drivers.<br>• Spirit level.<br>• Electrical drill.<br>• Multimeter.<br>• Insulation tester.<br>• Cable cutter.<br>• Hacksaw.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (b) Installing lighting points controlled by one way, two gang switch. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of a lighting circuit and its role in household or commercial electrical systems.<br>**Circuit Drawing:** Guide students to draw the layout of a typical lighting | **The students should be able to explain how to:**<br>• Prepare electrical drawings.<br>• Select tools, equipment and materials required.<br>• Prepare accessories and cables for lighting circuits.<br>• Install lighting | Lighting points are controlled by one way, two gang switch is installed as per IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install lighting points controlled by one-way, two-gang switch<br>**Principles:** The students should explain how to install lighting points controlled by one way, two-gang switch.<br>**Theories:** The students should | The following tools, safety gear and equipment are to be available:<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Claw hammer.<br>• Set of screwdrivers.<br>• Spirit level.<br>• Electrical drill. | |

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| | | | circuit,<br>**Demonstration**<br>Show students how to connect the circuit accessories<br>**Practice**<br>Provide students with the components (switch, light fixture, wiring) and guide them through installing lighting circuit controlled by one way, two gang switch. | circuit.<br>• Test the installation.<br>• Observe safety precautions.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | explain:<br>• Connection of lighting points controlled by one way, two gang switch<br>• IET regulations | • Multimeter.<br>• Insulation tester.<br>• Cable cutter.<br>• Hacksaw.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (c) Installing lighting points controlled by two-two way switches. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of a lighting circuit and its role in household or commercial electrical systems.<br>**Circuit Drawing:**<br>Guide students to draw the layout of | **The students should be able to explain how to:**<br>• Prepare electrical drawings.<br>• select tools, equipment and materials required.<br>• Prepare accessories and cables for lighting | lighting points controlled by two-two way switches is installed as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install lighting points controlled by two-two way switches<br>**Principles:**<br>The students should explain how to install lighting points controlled by two-two way switches | The following tools, safety gear and equipment are to be available:<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Claw hammer.<br>• Set of screw drivers. | |

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| | | | a typical lighting circuit,<br>**Demonstration**<br>Show students how to connect the circuit accessories<br>**Practice**<br>Provide students with the components (switch, light fixture, wiring) and guide them through installing a lighting circuit controlled by two-two way switches. | circuits.<br>• Install lighting circuit.<br>• Test the installation.<br>• Observe safety measures.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | **Theories:**<br>The students should explain<br>• connection of lighting points controlled by two-two way switches<br>• IET regulations | • Spirit level.<br>• Electrical drill.<br>• Multimeter.<br>• Insulation tester.<br>• Cable cutter.<br>• Hacksaw.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (d) Iinstalling lighting points controlled by two-two way switches and intermediate switch. | **Brainstorm**<br>Guide the students to discuss the purpose of a lighting circuit and its role in household or commercial electrical systems.<br>**Diagram the Circuit:**<br>Guide students to draw the layout of a typical lighting | **The students should be able to explain how to:**<br>• Prepare electrical drawings.<br>• Select tools, equipment and materials required.<br>• Prepare accessories and cables for lighting | lighting points controlled by two-two-way switches and an intermediate switch is installed as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install lighting points controlled by two two-way switches and intermediate switches.<br>**Principles:** The students should explain how to install lighting points controlled by two two- | The following tools, safety gear and equipment are to be available:<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Claw hammer.<br>• Set of screwdrivers. | |

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| | | | circuit,<br>**Demonstration**<br>Show students how to connect the circuit accessories<br>**Practice**<br>Provide students with the components (switch, light fixture, wiring) and guide them through installing lighting circuit controlled by two-two way switches and an intermediate switch. | circuits.<br>• Install lighting circuit.<br>• Test the installation.<br>• Apply safety measures.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | way switches and an intermediate switch.<br>**Theories:** The students should explain<br>• Connection of lighting points controlled by two-two way switches and an intermediate switch.<br>• IET regulations | • Spirit level.<br>• Electrical drill.<br>• Multimeter.<br>• Insulation tester.<br>• Cable cutter.<br>• Hacksaw.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | 4.2 Installing power circuits | (a) Installing radial circuit | **Brainstorm**<br>Guide the students to in defining, identifying and describing the purpose of a power circuit and its role in household or commercial electrical systems.<br>**Circuit Drawing:** | **The students should be able to explain how to:**<br>• Interpret the architectural drawing wiring diagram.<br>• Select tools, equipment and materials.<br>• Prepare accessories and | Radial circuit is installed as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install radial circuit.<br><br>**Principles:** The students should explain how to install radial circuit<br>**Theories:** The | The following tools, safety gear and equipment are to be available:<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Claw hammer. | 16 |

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| | | | Guide students to draw the layout of a typical power circuit,<br>**Demonstration**<br>Show students how to connect the circuit accessories<br>**Practice**<br>Provide students with the components (wire, distribution board and socket outlets) and guide them through installing the radial circuit | cable for power circuits.<br>• Install radial circuit.<br>• Carry out tests.<br>• Clean work area.<br>• Store tools, equipment and materials. | | students should explain<br>• connection of radial circuit<br>• Number of switch sockets allowed<br>• cross-sectional area of cable<br>• IET regulations | • Set of screw drivers.<br>• Spirit level.<br>• Electrical drill.<br>• Multimeter.<br>• Insulation tester.<br>• Cable cutter.<br>• Hacksaw.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (b) Installing ring and spur power circuit. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of a power circuit and its role in household or commercial electrical systems. | **The students should be able to:**<br>• Interpret the architectural drawing wiring diagram.<br>• Select tools, equipment and materials.<br>• Prepare accessories and | Ring and spur power circuit is installed as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to Install ring and spur power circuit.<br>**Principles:** The students should explain how to:<br>• Install ring and spur power circuit. | The following tools, safety gear and equipment should be available:<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Ball pen hammer.<br>• Cross peen | |

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| | | | **Circuit Drawing:** Guide students to draw the layout of a typical power circuit, **Demonstration** Show students how to connect the circuit accessories **Practice** Provide students with the components (wire, distribution board and socket outlets) and guide them through installing ring and spur power circuits. | cable for power circuits.<br>• Install ring/spur circuit.<br>• Carry out tests.<br>• Clean work area.<br>• Store tools, equipment and materials. | | • Allowed number of spurs in ring circuit<br>**Theories:** The students should explain:<br>• Connection diagram of ring and spur power circuit.<br>• Number of socket outlets allowed in ring and spur power circuit<br>• IET regulations | hammer.<br>• Claw hammer.<br>• Set of screwdrivers.<br>• Spirit level.<br>• Electrical drill.<br>• Multimeter.<br>• Megger.<br>• Insulation tester.<br>• Earth resistance tester<br>• Cable cutter.<br>• Hacksaw.<br>• Junior hacksaw.<br>• Master check probes.<br>• Wattmeter.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (c) Installing electric cooker circuit. | **Brainstorm** Guide the students in defining, identifying and describing the purpose of a cooker circuit and its role in household or commercial | **The students should be able to explain how to:**<br>• Interpret the architectural drawing wiring diagram.<br>• Select tools, equipment and materials.<br>• Prepare | Electric cooker circuit is installed as per IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install electric cooker circuit<br>**Principles:** The students should explain how to:<br>• Install electric | The following tools, safety gear and equipment should be available:<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers. | |

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| | | | electrical systems.<br>**Circuit Drawing:** Guide students to draw the layout of a typical cooker circuit<br>**Demonstration**<br>Show students how to connect the circuit accessories<br>**Practice**<br>Provide students with the components (wire, distribution board and cooker control unit) and guide them through installing the cooker circuit. | accessories and cable for power circuits.<br>• Install cooker control unit<br>• Carry out tests.<br>• Clean work area.<br>• Store tools, equipment and materials. | | cooker circuit<br>• Testing cooker installation<br>• Cross-sectional area of cable.<br>**Theories:** The students should explain:<br>• Meaning of cooker control unit.<br>• Connection diagram of cooker<br>• Cable cross-sectional area<br>• The application of protective devices<br>• The types of cables<br>• IET regulations | • Ball pen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Set of screwdrivers.<br>• Spirit level.<br>• Electrical drill.<br>• Multimeter.<br>• Megger.<br>• Insulation tester.<br>• Earth resistance tester<br>• Cable cutter.<br>• Hacksaw.<br>• Junior hacksaw.<br>• Master check probes.<br>• Wattmeter.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (d) Installing electric water heater circuit. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of a water heater and its role in household or | **The students should be able to explain how to:**<br>• Interpret the architectural drawing wiring diagram.<br>• Select tools, equipment and | The water heater is installed as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install a water heater circuit.<br>**Principles:** The students should | The following tools, safety gear and equipment are to be available:<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife. | |

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| | | | commercial electrical systems.<br>**Circuit Drawing:** Guide students to draw the layout of a typical water heater circuit<br>**Demonstration**<br>Show students how to connect the circuit accessories<br>**Practice**<br>Provide students with the components (wire, distribution board and water) and guide them through installing a water heater circuit. | materials.<br>• Prepare accessories and cable for power circuits.<br>• Install water heater.<br>• Carry out tests.<br>• Clean work area.<br>• Store tools, equipment and materials. | | explain how to:<br>• Install water heater.<br>• Testing water heater.<br>**Theories:** The students should explain:<br>• Operation of water heater<br>• Types of water heater<br>• Application of water heater<br>• Connection of water heater circuit<br>• Double pole switch<br>• IET regulations | • Measuring tape.<br>• Long nose pliers.<br>• Ball pen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Set of screwdrivers.<br>• Spirit level.<br>• Electrical drill.<br>• Multimeter.<br>• Megger.<br>• Insulation tester.<br>• Earth resistance tester<br>• Cable cutter.<br>• Hacksaw.<br>• Junior hacksaw.<br>• Master check probes.<br>• Wattmeter.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | 4.3 Installing alarm and signal circuits | (a) Installing single stroke bell circuit. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of a | **The students should be able to explain how to:**<br>• Draw a wiring diagram.<br>• Select required tools, | Single stroke bell circuit is installed as IET regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install single stroke bell | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers. | 24 |

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| | | | single-stroke bell circuit and its role in household or commercial electrical systems.<br>**Circuit Drawing:** Guide students to draw the layout of a typical single-stroke bell circuit<br>**Demonstration**<br>Show students how to connect the single-stroke bell circuit<br>**Practice**<br>Provide students with the components (wire, distribution board push switch and bell) and guide them through installing single stroke bell circuit | equipment and safety gear.<br>• Prepare accessories and cable for single stroke bell circuit.<br>• Install a single-stroke bell circuit.<br>• Test the circuit.<br>• Observe safety precautions.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | circuit<br>**Principles:** The students should explain how to<br>• install single-stroke bell circuit<br>• form electromagnetism<br><br>**Theories:** The students should explain:<br>• connection diagram of single stroke bell circuit.<br>• Bell push switch<br>• Types of materials used.<br>• IET regulations | • Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Cross peen hammer.<br>• Ball peen hammer.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Junior hacksaw.<br>• Cable cutter. | |
| | | (b) Installing trembler bell circuit. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of a trembler bell | **The students should be able to explain how to:**<br>• Draw a wiring diagram.<br>• Select the required tools, | The Trembler bell circuit is installed as per IET regulation | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install a trembler bell circuit | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers.<br>• Combination | |

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| | | | circuit and its role in household or commercial electrical systems. **Circuit Drawing:** Guide students to draw the layout of a typical trembler bell circuit **Demonstration** Show students how to connect the trembler bell circuit **Practice** Provide students with the components (wire, distribution board push switch and bell) and guide them through installing the trembler bell circuit | equipment and safety gear.<br>• Prepare accessories and cable for the trembler bell circuit.<br>• Install trembler bell circuit.<br>• Test the circuit.<br>• Observe safety precautions.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | **Principles:** The students be able to explain procedures of how to install a trembler bell circuit **Theories:** The students should explain:<br>• Connection diagram of trembler circuit.<br>• Select the specific size and capacity of the cable.<br>• Application of trembler bell circuit<br>• IET regulations | pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Cross peen hammer.<br>• Ball peen hammer.<br>• Analogue multimeter.<br>• Digital multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Junior hacksaw.<br>• Cable cutter. | |
| | | (c) Installinga continuous ringing bell circuit. | **Brainstorm** Guide the students in defining, identifying and describing the purpose of a continuous ringing bell circuit | **The students should be able to explain how to:**<br>• Draw a wiring diagram.<br>• Select required tools, equipment and | A continuous ringing bell circuit is installed as per IET regulation. | **Knowledge evidence: Detailed knowledge of:** **Methods used**: The students should explain how to install a continuous ringing bell circuit | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers. | |

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| | | | and its role in household or commercial electrical systems.<br>**Circuit Drawing:** Guide students to draw the layout of a typical continuous ringing bell circuit<br>**Demonstration**<br>Show students how to connect the continuous ringing bell circuit<br>**Practice**<br>Provide students with the components (wire, distribution board push switch and bell) and guide them through installing a continuous ringing bell circuit | safety gear.<br>• Prepare accessories and cable for continuous ringing bell circuit.<br>• Install continuous ringing bell circuit.<br>• Test the continuous ringing bell circuit.<br>• Observe safety precautions.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | **Principles:** The students should explain how to install continuous ringing bell circuit<br>**Theories:** The students should explain:<br>• Operation of continuous ringing bell circuit<br>• Connection diagram of continuous ringing bell circuit.<br>• Application continuous ringing bell circuit<br>• IET regulation | • Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Cross peen hammer.<br>• Ball peen hammer.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Junior hacksaw.<br>• Cable cutter. | |
| | | (d) Installing buzzer circuit. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of a | **The students should be able to explain how to:**<br>• Draw a wiring diagram.<br>• Select required | The Buzzer circuit is installed as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install a | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | buzzer circuit and its role in household or commercial electrical systems.<br>**Diagram the Circuit:**<br>Guide students to draw the layout of a typical buzzer circuit<br>**Demonstration**<br>Show students how to connect the buzzer circuit<br>**Practice**<br>Provide students with the components (wire, distribution board push switch and bell) and guide them through installing the buzzer circuit | tools, equipment and safety gear.<br>• Prepare accessories and cable for the buzzer circuit.<br>• Install buzzer circuit.<br>• Test the circuit.<br>• Observe safety precautions.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | buzzer circuit<br><br>**Principles:** The students should explain the steps how to install a buzzer circuit<br>**Theories:** The students should explain:<br>• Operation of buzzer<br>• Connection diagram of buzzer circuit<br>• Application of buzzer circuit<br>• IET regulations | • Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Cross peen hammer.<br>• Ball peen hammer.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Junior hacksaw.<br>• Cable cutter. | |
| | | (e) Installing indicator board circuit. | **Brainstorm**<br>Guide the students to discuss the purpose of indicator board circuits and their role in household | **The students should be able to explain how to:**<br>• Draw a wiring diagram.<br>• Select required tools, | The indicator board circuit was installed as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install an indicator board | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers.<br>• Combination | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | or commercial electrical systems.<br><br>**Circuit Drawing:** Guide students to draw the layout of a typical indicator board circuit<br>**Demonstration**<br>Show students how to connect the indicator board circuit<br>**Practice**<br>Provide students with the components (wire, distribution board push switch and bell) and guide them through installing the indicator board circuit | equipment and safety gear.<br>• Prepare accessories and cable for the indicator board circuit.<br>• Install indicator board circuit.<br>• Test the circuit.<br>• Observe safety precautions.<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | circuit<br>**Principles:** The students should explain how to install an indicator board circuit **Theories:** The students should explain:<br>• Connection diagram of indicator board circuit<br>• Application of indicator board circuit<br>• IET regulations | pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Cross peen hammer.<br>• Ball peen hammer.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Overall.<br>• Junior hacksaw.<br>• Cable cutter. | |
| | 4.4 Installing Basic Protective Device | (a) Installingsingle-phasee protective devices. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of single-phase protective | **The students should be able to explain how to:**<br>• Identify types and ratings of | A single-phase protective device is installed as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install single-phase protective | The following tools, safety gear and equipment are to be available:<br>:<br>• Set of spanners. | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | devices household or commercial electrical systems.<br><br>**Circuit Drawing:** Guide students to draw the layout of a typical single-phase protective device<br>**Demonstration** Show students how to connect the single-phase protective devices<br>**Practice** Provide students with the tools, materials and single-phase protective and guide them to install single-phase protective devices | single-phase protective devices.<br>• Types and rating of fuses.<br>• Install single-phase protective devices.<br>• Observe safety precautions<br>• Clean the workplace.<br>• Store tools, equipment and remaining materials. | | devices<br><br>**Principles:** The students should explain how to install single-phase protective devices<br>**theories:** The students should explain:<br>• Operation of earth leakage circuit breaker (voltage and current operated)<br>• Fuses and their types<br>• Miniature circuit breaker<br>• IET regulations | • Set of semi-insulated screwdrivers.<br>• multimeter<br>• Workbench.<br>• Safety boots.<br>• Safety goggles.<br>• Safety plastic and leather gloves.<br>• Overall.<br>• Combination plier.<br>• Long nose plier.<br>• Side cutter plier.<br>• Spirit level. | |
| | | (b) Installingthree-phasee protective devices. | **Brainstorm** Guide the students to discuss the | **The students should be able to explain how to:** | Three-phase protective devices are | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The | The following tools, safety gear and equipment are to be available: | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | purpose of three-phase protective devices household or commercial electrical systems.<br>**Circuit Drawing:** Guide students to draw the layout of a typical three-phase protective device<br>**Demonstration**<br>Show students how to connect the three-phase protective devices<br>**Practice**<br>Provide students with the tools, materials and three-phase protective and guide them to install three-phase protective devices | • Identify types and ratings of three three-phase protective devices.<br>• Types and rating of fuses.<br>• Install three-phase protective devices.<br>• Observe safety precautions<br>• Clean the workplace.<br>• Store tools, equipment and remaining materials. | installed as per IET regulations. | students should explain how to install three three-phase protectives<br>**Principles:** The students should explain how to install three-phase protective devices.<br>**Theories:** The students should explain:<br>• Operation of three-phase earth leakage circuit breaker (voltage and current operated)<br>• IET regulations | :<br>• Set of spanners.<br>• Set of semi-insulated screwdrivers .<br>• multimeter<br>• Workbench.<br>• Safety boots.<br>• Safety goggles.<br>• Safety plastic and leather gloves.<br>• Overall.<br>• Combination plier.<br>• Long nose plier.<br>• Side cutter plier.<br>• Spirit level. | |
| | 4.5 Carrying Out Earthing Systems | (a) Performing TT earthing methods | **Brainstorm**<br>Guide the students to discuss the purpose of TT earthing in household or commercial | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Draw wiring | TT earthing systems is performed as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform TT earthing | The following tools, safety gear and equipment are to be available:<br>• Clamp on meter.<br>• Megger meter.<br>• Ground resistance | 24 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | electrical systems.<br><br>**Circuit Drawing:** Guide students to draw the layout of a typical TT earthing system<br>**Demonstration** Show students how to connect TT earthing<br>**Practice** Provide students with the tools, materials and Earth electrode and guide them to install the TT earthing system | diagrams.<br>• Identify the earthing electrodes.<br>• Install the TT earthing systems.<br>• Test the function of TT earthing.<br>• Observe safety precautions.<br>• Clean the workplace, tools and equipment.<br>• Store tools, equipment and remaining materials. | | methods.<br>**Principles:** The students should explain how to:<br>• Perform Earthing.<br>• Measure earth resistance<br>**Theories:** The students should explain:<br>• Measurement of earth resistance.<br>• Allowable earth resistance<br>• Reducing earth resistance<br>• Earth continuity conductor<br>• Earth led<br>• Earth<br>• Connection diagram of earthing systems<br>• Meaning of TT<br>• Application of TT<br>• electrode<br>• IET regulations | meter<br>• Set of spanners.<br>• Hoe.<br>• Spade.<br>• Set of screwdrivers.<br>• Safety boots.<br>• Safety goggles.<br>• Plastic gloves.<br>• Soil resistance-reducing compound<br>• Overall. | |
| | | (b) Performing IT earthing methods | **Brainstorm** Guide the students to discuss the purpose of IT earthing in household or | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear | IT earthing systems is installed as per IET regulations. | • The students should explain how to Perform IT earthing methods<br>**Principles:** The students should | The following tools, safety gear and equipment are to be available:<br>• Clamp on meter.<br>• Megger meter. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | commercial electrical systems.<br><br>**Circuit Drawing:** Guide students to draw the layout of a typical IT earthing system<br>**Demonstration** Show students how to connect IT earthing<br>**Practice** Provide students with the tools, materials and Earth electrodes and guide them to install the IT earthing system | • Draw wiring earthing circuit diagrams.<br>• Identify the earthing electrodes.<br>• Install the IT earthing systems.<br>• Test the function of IT earthing.<br>• Observe safety precautions.<br>• Clean the workplace, tools and equipment.<br>• Store tools, equipment and remaining materials. | | explain the principles of Performing IT earthing methods<br>**Theories:** The students should explain:<br>• Connection diagram of IT earthing<br>• Meaning of IT<br>• Application of IT<br>• IET regulations | • Ground resistance meter<br>• Set of spanners.<br>• Hoe.<br>• Spade.<br>• Set of screwdrivers.<br>• Safety boots.<br>• Safety goggles.<br>• Plastic gloves.<br>• Soil resistance-reducing compound<br>• Overall. | |
| | | (c) Performing TNS earthing methods | **Brainstorm** Guide the students in defining, identifying and describing the purpose of TNS earthing in household or commercial electrical systems.<br>**Circuit Drawing:** | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Draw wiring earthing circuit diagrams.<br>• Identify the earthing | TNS earthing systems is installed as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform TNS earthing methods<br>**Principles:** The students should explain how to | The following tools, safety gear and equipment are to be available:<br>: -<br>• Clamp on meter.<br>• Megger meter.<br>• Ground resistance meter<br>• Set of spanners.<br>• Hoe. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | Guide students to draw the layout of a typical TNS earthing system<br>**Demonstration**<br>Show students how to connect TNS earthing<br>**Practice**<br>Provide students with the tools, materials and Earth electrode and guide them to install the TNS earthing system | electrodes.<br>• Install the TNS earthing systems.<br>• Test the function of TNS earthing.<br>• Observe safety precautions.<br>• Clean the workplace, tools and equipment.<br>• Store tools, equipment and remaining materials. | | perform TNS earthing methods<br>**Theories:** The students should explain:<br>• Meaning of TNS systems.<br>• Connection diagram of TNS<br>• The application of TNS, systems.<br>• IET regulation | • Spade.<br>• Set of screwdrivers.<br>• Safety boots.<br>• Safety goggles.<br>• Plastic gloves.<br>• Soil resistance-reducing compound<br>• Overall. | |
| | | (d) Performing bonding of metal fixtures | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of metal bonding in household or commercial electrical systems.<br>**Diagram the Circuit:**<br>Guide students to draw the layout of a typical metal bonding | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Draw wiring earthing circuit diagrams.<br>• Identify the metal cases in installation<br>• perform the bonding of metal fixtures<br>• Observe safety | Bonding of metal fixtures is performed as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform bonding of metal fixtures methods<br>**Principles:** The students should explain to perform bonding of metal fixtures methods<br>**Theories:** The students should explain:<br>• Meaning of | The following tools, safety gear and equipment are to be available:<br>• Set of spanners.<br>• Set of screwdrivers.<br>• Safety boots.<br>• Safety goggles.<br>• Plastic gloves.<br>• Overall. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | **Demonstration**<br>Show students how to connect metal bonding<br>**Practice**<br>Provide students with the tools, materials and Earth electrode and guide them to install the metal bonding system | precautions.<br>• Clean the workplace, tools and equipment.<br>• Store tools, equipment and remaining materials. | | bonding<br>• Importance of bonding<br>• Electric shock<br>• IET regulation | | |
| | 4.6 Carrying Out Electrical Tests | (a) Carrying out verification of polarity test. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of verification of polarity test installation.<br>**Demonstration**<br>Show students how to verify the polarity of the new installation<br>**Practice**<br>Provide students with the tools, measuring equipment and power supply and | **The students should be able to explain how to:**<br>• Select tools, equipment and materials<br>• Carry out polarity tests<br>• Record test results in the record book.<br>• Analyse the recorded data.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | Verification of polarity test is carried out as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to carry out verification of the polarity test<br>**Principles:** The students should explain how to carry out verification of the polarity test installation.<br>**Theories:** The students should explain:<br>• Polarity test of installation<br>• Connection diagram on | The following tools, safety gear and equipment are to be available:<br>• Continuity tester.<br>• Earth fault loop tester.<br>• Side cutters.<br>• Insulation tester.<br>• Combination pliers.<br>• Set of screwdrivers.<br>• Test lamp.<br>• Set of spanners.<br>• multimeter.<br>• Overall.<br>• Safety boot.<br>• Safety goggles.<br>• Plastic gloves. | 24 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | guide them to practice verification of polarity | | | verification of polarity test<br>• IET regulation | | |
| | | (b) Carrying out insulation test | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of the insulation test of installation.<br>**Demonstration**<br>Show students how to test the insulation of the new installation<br>**Practice**<br>Provide students with the tools, measuring equipment and power supply and guide them to practice insulation test | **The students should be able to explain how to:**<br>• Select tools, equipment and materials<br>• Carry out insulation test<br>• Record test results in the record book.<br>• Analyse the recorded data.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | The insulation test is carried out as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to carry out insulation test<br>**Principles:** The students should explain how to carry out the insulation test of a complete installation.<br>**Theories:** The students should explain:<br>• Insulation test in installation<br>• Connection diagram on insulation test<br>• IET regulation | The following tools, safety gear and equipment are to be available:<br>• Continuity tester.<br>• Earth fault loop tester.<br>• Side cutters.<br>• Insulation tester.<br>• Combination pliers.<br>• Set of screwdrivers.<br>• Test lamp.<br>• Set of spanners.<br>• multimeter.<br>• Overall.<br>• Safety boot.<br>• Safety goggles.<br>• Plastic gloves. | |
| | | (c) Carrying out ring circuit test. | **Brainstorm**<br>Guide the students in defining, identifying and describing the | **The students should be able to explain how to:**<br>• Select tools, equipment and | Ring circuit test is carried out as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should | The following tools, safety gear and equipment are to be available:<br>• Continuity tester. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | purpose of the ring circuit test of installation.<br>**Demonstration**<br>Show students how to ring circuit test of the new installation<br>**Practice**<br>Provide students with the tools, measuring equipment and power supply and guide them to practice insulation test | materials<br>• Carry out ring circuit test<br>• Record test results in the record book.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | | explain how to carry out ring circuit tests**.**<br>**Principles:** The students should be able to demonstrate the correct procedures and techniques for performing a ring circuit test<br>**Theories:** The students should explain:<br>• Ring circuit test installation<br>• Connection diagram on ring circuit test<br>• IET regulation | • Earth fault loop tester.<br>• Side cutters.<br>• Insulation tester.<br>• Combination pliers.<br>• Set of screwdrivers.<br>• Test lamp.<br>• Set of spanners.<br>• multimeter.<br>• Overall.<br>• Safety boot.<br>• Safety goggles.<br>• Plastic gloves. | |
| | | (d) Carrying out earthing resistance test. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of the earth resistance test of installation.<br>**Demonstration**<br>Show students how to test earth resistance<br>**Practice**<br>Provide students with the tools, | **The students should be able to explain how to:**<br>• Select tools, equipment and materials<br>• Carry out earthing resistance test<br>• Record test results in the record book.<br>• Observe safety precautions<br>• Clean work | Earthing resistance test is carried out as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to carry out earthing resistance test **Principles:** The Students should be able to demonstrate the correct procedures for performing an earthing resistance test.<br>**Theories:** The students should explain: | The following tools, safety gear and equipment are to be available:<br>• Continuity tester.<br>• Earth fault loop tester.<br>• Side cutters.<br>• Insulation tester.<br>• Combination pliers.<br>• Set of screwdrivers.<br>• Test lamp.<br>• Set of spanners. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | measuring equipment and power supply and guide them to practice earth resistance measurement | area.<br>• Store tools, equipment and remaining materials. | | • Earthing resistance test installation<br>• Connection diagram on earthing resistance test<br>• IET regulation | • multimeter.<br>• Overall.<br>• Safety boot.<br>• Safety goggles.<br>• Plastic gloves. | |
| | | (e) Carrying out continuity test of the installation. | **Brainstorm**<br>Guide the students in defining, identifying and describing the purpose of the continuity test of installation.<br>**Demonstration**<br>Show students how to continuity test of the new installation<br>**Practice**<br>Provide students with the tools, measuring equipment and power supply and guide them to practice continuity test | **The students should be able to explain how to:**<br>• Select tools, equipment and materials<br>• Carry out continuity test of the installation<br>• Record test results in the record book.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remaining materials. | Continuity test of the installation is carried out as per IET regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to carry out the continuity test of the installation<br>**Principles:** Students should be able to state the correct procedures for performing a continuity test of the installation.<br>**Theories:** The students should explain:<br>• continuity test of the installation<br>• Connection diagram on continuity test of the installation<br>• IET regulation | The following tools, safety gear and equipment are to be available:<br>• Continuity tester.<br>• Earth fault loop tester.<br>• Side cutters.<br>• Insulation tester.<br>• Combination pliers.<br>• Set of screwdrivers.<br>• Test lamp.<br>• Set of spanners.<br>• multimeter.<br>• Overall.<br>• Safety boot.<br>• Safety goggles.<br>• Plastic gloves. | |
| | | (f) Carryout | **Brainstorm** | **The students** | Open circuit | **Knowledge evidence:** | The following tools, | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | open circuit test in the installation | Guide the students to discuss the purpose of open circuit test of installation.<br>**Demonstration**<br>Show students how to open circuit test of the new installation<br>**Practice**<br>Provide students with the tools, and measuring equipment and guide them to practice open circuit test | **should be able to explain how to:**<br>• Select of tools, equipment and materials<br>• Carry out open circuit test in the installation<br>• Record test results in the record book.<br>• Analyse the recorded data.<br>• Observe safety precautions<br>• Clean work area.<br>• Store tools, equipment and remained materials. | test in the installation is carried out as per IET regulations. | **Detailed knowledge of:**<br>**Methods used**: The students should explain how to carry out open circuit test in the installation<br><br>**Principles:** Students should be able to state the correct procedures for performing an open circuit test in the installation ensuring adherence to safety protocols.<br>**Theories:** The students should explain:<br>• open circuit test in the installation<br>• Connection diagram on open circuit test in the installation<br>• IET regulation | safety gear and equipment are to be available:<br>• Continuity tester.<br>• Earth fault loop tester.<br>• Side cutters.<br>• Insulation tester.<br>• Combination pliers.<br>• Set of screw drivers.<br>• Test lamp.<br>• Set of spanners.<br>• multimeter.<br>• Overall.<br>• Safety boot.<br>• Safety goggles.<br>• Plastic gloves. | |

## Form Three

**Table 5:** *Detailed Contents for Form Three*

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| 1.0 Installing cables and cable enclosures | 1.1 Installing cables | (a) Installing PVC cables | **Description**<br>Guide the students to describe the construction, insulation properties, and advantages of PVC cables.<br>**Demonstration**<br>Show students how to measure, cut and strip PVC cables without damaging the conductor<br>**Practice**<br>Provide students with PVC cables, tools, and materials to practice cutting and stripping PVC cables. | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret wiring drawings<br>• Select an area for cable installation<br>• Lay the cable and clip it<br>• Terminate cable<br>• Observe safety precaution<br>• Clean work area.<br>• Store tools, equipment and safety gear. | PVC cables are installed as per IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to install PVC cables<br>**Principle:** Students should be able to explain the correct procedures for the installation of PVC cables.<br>**Theories:** The students should explain<br>• Types of cables and uses<br>• Type of material for manufacturing cables<br>• Cable colour coding<br>• Cable insulating material<br>• Steps to consider for | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Set of screwdrivers.<br>• Cable pulling socks<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | | | | PVC cable installation | | |
| | | (b) Installing paper insulated cables | **Description**<br>Guide the students to describe the construction, insulation properties, and advantages of paper-insulated cables.<br>**Demonstration**<br>ShowShow students how to measure, cut and strip paper insulated cables without damaging the conductor<br>**Practice**<br>Provide students with PVC cables, tools, and materials to practice cutting and stripping paper-insulated cables. | **The students should be able to explain how to:**<br>• Select tools, equipment safety gear and materials<br>• Interpret wiring drawings<br>• Select an area for paper-insulated cable installation<br>• Install paper insulated cables<br>• Terminate cable<br>• Observe safety precaution<br>• Clean work area.<br>• Store tools, equipment and safety gear. | Paper-insulated cables are installed as per IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to install paper-insulated cables<br><br>**Principle:** Students should be able to indicate the correct procedures for installing paper-insulated cables<br><br>**Theories:** The students should explain<br>• paper insulated cables<br>• Steps to consider for paper insulated cables<br>• IET regulations | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Set of screwdrivers.<br>• Cable pulling socks<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | |
| | | (c) Installing armoured cables | **Description**<br>Guide the students to | **The students should be able to explain how to** | An armoured cable is installed as per | **Knowledge evidence:**<br>**Detailed** | The following tools, safety gear and equipment are to be available: | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | describe construction, insulation properties, and advantages of armoured cables.<br>**Demonstration**<br>ShowShow students how to measure, cut and strip armoured without damaging the conductor<br>**Practice**<br>Provide students with PVC cables, tools, and materials to practice cutting and stripping armoured cable. | **explain how:**<br>• Select tools, equipment and safety gear<br>• Interpret wiring drawings<br>• Select area for armoured cables installation<br>• Install armoured cables<br>• Terminate cable<br>• Observe safety precaution<br>• Clean work area.<br>• Store tools, equipment's and safety gear. | IET regulations. | **knowledge of: Methods used**<br>The students should explain how to install armoured cables<br><br>**Principle:** Students should be able to demonstrate the correct procedures for installing armoured cables<br><br>**Theories:** The students should explain<br>• Armoured cables<br>• Steps to consider for armoured cables<br>• IET regulations | • Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Set of screw drivers.<br>• Cable pulling socks<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | |
| | | (d) Performing underground wiring systems | **Discussion**<br>Guide the students to discuss benefit underground wiring system<br>**Demonstration**<br>Show students | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret | Underground wiring systems are performed as per IET regulations. | **Knowledge evidence: Detailed knowledge of: Methods used**<br>The students should explain how to perform | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife. | |

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| | | | how to dig a trench to the required depth<br>**Visit**<br>Let students to visit premises with underground wiring to visualize its benefit | wiring drawings<br>• Select area for underground wiring systems installation<br>• Install underground wiring systems<br>• Terminate cable<br>• Observe safety precaution<br>• Clean work area.<br>• Store tools, equipment's and safety gear. | | underground wiring systems<br>**Principle: The** students should be able to demonstrate the correct procedures for underground wiring systems ensuring adherence to safety protocols and industry standards.<br>**Theories:** The students should explain<br>• Underground wiring systems<br>• Steps to consider for underground wiring systems<br>• IET regulations | • Measuring tape.<br>• Long nose pliers.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Set of screw drivers.<br>• Cable pulling socks<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | |
| | 1.2 Erecting conduits | (a) Erecting PVC conduits. | **Discussion**<br>Guide the students to discuss the construction and application of PVC conduit<br>**Demonstration**<br>Show students how to measure length, cut and | **The students should be able to explain how to:**<br>• Interpret architectural drawing.<br>• Draw electrical diagrams.<br>• Select tools, equipment | PVC conduit is erected as per the IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>the students should explain how to erect PVC conduits<br>**Principles:** The Students should be able to demonstrate | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Ball peen hammer. | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | bend PVC conduit<br>**Practice**<br>Provide students with tools and PVC conduit to practice installation of PVC conduit | and materials required.<br>• Mount the PVC conduit.<br>• Clean work area.<br>• Store tools, equipment and safety gear. | | the correct procedures for erecting conduits with accuracy<br><br>**Theories:** The students should explain:<br>• Types and size of PVC conduit.<br>• Types of bends and joints.<br>• IET regulation | • Cross peen hammer.<br>• Claw hammer.<br>• Set of screw drivers.<br>• Bench vice.<br>• Bending block.<br>• Bending machine.<br>• Draw wire (snake wire).<br>• Round files.<br>• Reamer.<br>• Stock and die.<br>• Power saw.<br>• Pipe vice.<br>• Spirit level.<br>• Chisel.<br>• Chest drill machine.<br>• Pipe cuter.<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | |
| | | (b) Erecting galvanized conduits. | **Discussion**<br>Guide the students to discuss the construction and application of galvanized conduits<br>**Demonstration**<br>Show students how to measure length, cut and | **The students should be able to:**<br>• Interpret architectural drawing.<br>• Draw electrical diagrams.<br>• Select tools, equipment and materials | Galvanized conduit is erected **as** per the IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to erect galvanized conduit.<br><br>**Principles:**<br>Students should be able to state the | The following tools, safety gear and equipment are to be available:<br>• Diagonal cutting pliers.<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Ball peen hammer.<br>• Cross peen hammer. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | bend galvanized conduits<br><br>**Practice**<br>Provide students with tools and PVC conduit to practice installation of galvanized conduits | required.<br>• Mount the conduit.<br>• Clean work area.<br>• Store tools, equipment and safety gear. | | correct procedures for erecting galvanized conduits<br><br>**Theories:** The students should explain:<br>• Types and size of galvanized conduits.<br>• Types of bends and joints.<br>• IET regulations | • Claw hammer.<br>• Set of screw drivers.<br>• Bench vice.<br>• Bending block.<br>• Bending machine.<br>• Draw wire (snake wire).<br>• Round files.<br>• Reamer.<br>• Stock and die.<br>• Power saw.<br>• Pipe vice.<br>• Spirit level.<br>• Chisel.<br>• Chest drill machine.<br>• Pipe cuter.<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | |
| | 1.3 Erecting trunking and cable trays | (a) Erecting PVC trunking. | **Discussion**<br>Guide the students to discuss the construction and application of PVC trunking<br>**Demonstration**<br>Show students how to measure length, cut and bend PVC trunking | **The students should be able to explain how to:**<br>• Draw the plan of the work.<br>• Select tools, equipment and materials required.<br>• Install trunking.<br>• Observe | PVC trunking is erected as per IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should be able to explain how to erect PVC truncking<br><br>**Principles:**<br>Students should be able to demonstrate | The following tools, safety gear and equipment are to be available:<br>• Junior hacksaw.<br>• Hacksaw.<br>• Set of screw drivers.<br>• Set of spanners.<br>• Set of files.<br>• Overall.<br>• Safety boots.<br>• Safety goggles.<br>• Leather gloves. | 16 |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | **Practice**<br>Provide students with tools and PVC conduit to practice installation of PVC trunking | safety precautions<br>• Clean the work place.<br>• Store tools and material remained. | | the correct steps for erecting PVC trunking<br>**Theories:** The students should explain:<br>• Types of trunking<br>• IET regulation | • Spirit level.<br>• Hammer. | |
| | | (b) Install skirting trunking | **Discussion**<br>Guide the students to discuss the construction and application of skirting trunking<br>**Demonstration**<br>Show students how to measure length, cut and bend skirting trunking<br><br>**Practice**<br>Provide students with tools and PVC conduit to practice installation of skirting trunking | **The students should be able to explain how to:**<br>• Draw the plan of the work.<br>• Select tools, equipment and materials required.<br>• Install skirting trunking<br>• Observe safety precautions<br>• Clean the work place.<br>• Store tools and material remained. | • Installation of skirting trunking is performed as per IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should be able to explain how to install skirting trunking<br><br>**Principles:**<br>Students should be able to demonstrate the correct procedures for installing skirting trunking<br>**Theory:** the students should be able to explain<br>• Skirting trunking<br>• IET regulation | The following tools, safety gear and equipment are to be available:<br>• Junior hacksaw.<br>• Hacksaw.<br>• Set of screw drivers.<br>• Set of spanners.<br>• Set of files.<br>• Overall.<br>• Safety boots.<br>• Safety goggles.<br>• Leather gloves.<br>• Spirit level.<br>• Hammer. | |
| | | (c) Erecting cable | **Discussion**<br>Guide the | **The students should be able to** | Cable trays.is erected as per | **Knowledge evidence:** | The following tools, safety gear and equipment are to | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | trays. | students to discuss the construction and application of cable trays<br>**Demonstration**<br>Show students how to measure length, cut and bend cable trays<br><br>**Practice**<br>Provide students with tools and PVC conduit to practice installation of cable trays | **explain how to:**<br>• Draw the plan of the work.<br>• Select tools, equipment and materials required.<br>• Install cable trays.<br>• Observe safety precautions<br>• Clean the work place.<br>• Store tools and material remained. | IET regulations. | **Detailed knowledge of: Methods used**<br>The students should be able to explain how to erect cable trays.<br>**Principles:**<br>Students should be able to demonstrate the correct procedures for erecting cable trays with precision and accuracy.<br>**Theory** the students should be able to explain<br>• Cable tray<br>• IET regulation | be available:<br>• Junior hacksaw.<br>• Hacksaw.<br>• Set of screw drivers.<br>• Set of spanners.<br>• Set of files.<br>• Overall.<br>• Safety boots.<br>• Safety goggles.<br>• Leather gloves.<br>• Spirit level.<br>• Hammer. | |
| | 1.4 Constructing ducts and trenches | (a) Constructing ducting system | **Discussion**<br>Guide the students to Discuss the types, uses, and benefits of ducting systems<br><br>**Demonstration**<br>Show students how to create a duct layout based on airflow requirements | **The students should be able to explain how to:**<br>• Select materials, equipment and tools for constructing ducts<br>• Interpret drawings<br>• Prepare site for construction | Duct is constructed as per IET Regulations. | **Knowledge evidence:**<br>**Detailed knowledge of: Methods used**<br>The students should explain how to construct ducts<br><br>**Principle:** Students should be able to demonstrate the correct procedures for constructing | The following tools, safety gear and equipment are to be available:<br>• Electrician's tool kit<br>• Hammer,<br>• Lock Forming Machine<br>• Shrimp Bend Machines<br>• Hand drill<br>• Excavator machines<br>• Cable plastic protecting cover<br>• Safety boots | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | **Practice**<br>Guide the students to practice construction of ducts | of ducts<br>• Construct ducts as per requirement<br>• Observe safety precautions<br>• Clean the work area<br>• Store tools, equipment and safety gear | | ducts and trenches<br><br>**Theories:** The students should explain:<br>• Types of Ducts and their applications<br>• IET regulations | • Overalls<br>• Gloves<br>• Safety helmets<br>• Safety goggles | |
| | | (b) Constructing cable trenches | **Discussion**<br>Guide the students to discuss the role of cable trenches in utility and infrastructure projects<br><br>**Demonstration**<br>Show students how to how to measure and mark the trench path<br><br>**Practice**<br>Guide the students to measure, mark, and excavate a trench | **The students should be able to explain how to:**<br>• Select materials, equipment and tools for constructing cable trenches<br>• Interpret drawings<br>• Prepare site for construction of cable trenches<br>• Construct cable trenches as per | Cable trench is constructed as per IET Regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to construct cable trenches<br><br>**Principle:** The students should be able to explain the steps how to construct cable trenches<br><br>**Theories:** The students should explain:<br>• Types of cable | The following tools, safety gear and equipment are to be available:<br>• Electrician's tool kit<br>• Hammer,<br>• Lock Forming Machine<br>• Shrimp Bend Machines<br>• Hand drill<br>• Excavator machines<br>• Cable plastic protecting cover<br>• Safety boots<br>• Overalls<br>• Gloves<br>• Safety helmets<br>• Safety goggles | |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | | requirement<br>• Observe safety precautions<br>• Clean the work area<br>• Store tools, equipment and safety gear | | trenches and their applications<br>• IET regulation | | |
| 2.0 Installing switch gear and protective device | 2.1 Installing switch gear | (a) Installing three phase distributio n board. | **Discussion**<br>Guide students to discuss the role of distribution board in power distribution<br><br>**Demonstration**<br>Show students how to step by step of mounting DB on a wall and make terminations<br><br>**Practice**<br>Provide students with tools and mock setups to practice three phase DB installation. | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools, equipment and safety gear<br>• Install three phase distribution board<br>• Observe safety precautions<br>• Clean the work area.<br>• Collect all tools and other items for storage. | Three phase distribution board is installed as per IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to Install three phase distribution board<br><br>**Principles:** The students should be able to demonstrate the correct procedures for installing a three-phase distribution board<br><br>**Theories:** The students should explain:<br>• Three phase distribution | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs.<br>• A set of screw drivers.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Megger.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Safety goggles.<br>• Overall.<br>• Safety boots.<br>• multimeter | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | board.<br>• Protective device available in distribution board<br>• IET regulation. | | |
| | | (b) Installing change over switches | **Discussion**<br>Guide students to discuss the types and applications of changeover switch in installation<br><br>**Demonstration**<br>Show students how to connect cables to busbars and circuit breakers.<br><br>**Practice**<br>Provide students with switchgear panels to practice placement and anchoring | **The students should be able to explain how to:**<br>• Interpret single line and lay out drawings.<br>• Select tools, equipment and safety gear<br>• Install manually operated change over switches.<br>• Install automatically operated change over switches.<br>• Observe safety precautions<br>• Clean the work area.<br>• Collect all | Change over switches is installed as per and IET regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should be able to explain how to install change over switches.<br><br>**Principles:**<br>The students should be able to state the correct steps how to install change over switches<br><br>**Theories:** The students should explain:<br>• Types and application of changeover switch<br>• Operation of changeover | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs.<br>• A set of screw drivers.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Megger.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Safety goggles.<br>• Overall.<br>• Safety boots.<br>• multimeter | |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | | tools and other items for storage. | | • switches<br>• IET regulations | | |
| | | (c) Installing power factor correction facilities. | **Role play**<br>Guide the students to use example of glass of water with foam where real power is water, reactive power is foam, and apparent power is the total content<br><br>**Discussion**<br>Guide the students to discuss how presence of inductive loads lower the PF<br>**Demonstration**<br>Show students how to measure PF of the systems<br>Practice<br>Provide students with power factor correction device to practice its installation | **The students should be able to explain how to:**<br>• Interpret single line and lay out drawings.<br>• Select tools, equipment and safety gear<br>• Install power factor facilities.<br>• Observe safety precautions<br>• Clean the work area.<br>• Collect all tools and other items for storage. | Power factor correction facilities are installed as per and IET regulations. | **Knowledge evidence:**<br><br>**Detailed knowledge**<br><br>**Methods used:**<br>The students should explain how to:<br>Install power factor facilities.<br>**Principles:**<br>The students should be able to demonstrate the correct procedures for installing power factor correction facilities<br>**Theory: the students should explain:**<br>• Inductive and resistive load<br>• Apparent power, active power and reactive power<br>• Power factor<br>• Methods of correcting | The following tools and equipment should be available:<br>• Rawl plugs.<br>• A set of screw drivers.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Claw hammer.<br>• Megger.<br>• Combination pliers.<br>• Diagonal cutting pliers.<br>• Electrician knife.<br>• Safety goggles.<br>• Overall.<br>• Safety boots. | |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | | | | power factor | | |
| | 2.2 Installing protective devices | (a) Installing three phase over-current protective devices. | **Discussion**<br>Guide students to identify ratings, trip curves, and terminal connections three phase over-current protective device<br>**Demonstration**<br>Show students how to properly mount and wire fuses and circuit breakers.<br><br>**Practice**<br>Provide students with three phase over current protection relay to practice its installation | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret single line and lay out drawings.<br>• Install three phase over-current protective devices.<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear. | three phase over-current protective devices is installed as per IET regulations | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to install three phase over-current protective devices.<br><br>**Principles:**<br>Students should be able to demonstrate the correct procedures for installing three-phase over-current protective devices<br>**Theories:** The students should explain:<br>• Operation of three phase over-current protective devices.<br>• Types and functions of three-phase over-current protective devices. | The following tools and equipment should be available:<br>• Set of spanners.<br>• Set of semi- insulated screw drivers.<br>• Analogue and digital multimeter.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Safety plastic and leather gloves.<br>• Overall.<br>• Combination pliers.<br>• Long nose s.<br>• Side cutter pliers.<br>• Spirit level. | 16 |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | | | | • IET regulation | | |
| | | (b) Installing three phase earth leakage protective devices | **Discussion**<br>Guide students to identify ratings, trip curves, and terminal connections three phase earth leakage protective devices<br>**Demonstration**<br>Show students how to properly mount and wire fuses and circuit breakers.<br><br>**Practice**<br>Provide students with three phase earth leakage protective devices to practice its installation | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret single line and lay out drawings.<br>• Install three phase earth leakage protective devices<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear. | Three phase earth leakage protective devices installed as per IET regulations | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to Install three phase earth leakage protective devices<br><br>**Principles:** The students should be able to follow the correct procedures for installing three phase earth leakage protective devices<br><br>**Theories:** The students should explain:<br>• Operation of three phase earth leakage protective devices<br>• IET regulations | The following tools and equipment should be available:<br>• Set of spanners.<br>• Set of semi -insulated screw drivers.<br>• Analogue and digital multimeter.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Safety plastic and leather gloves.<br>• Overall.<br>• Combination pliers.<br>• Long nose s.<br>• Side cutter pliers.<br>• Spirit level. | |
| | | (c) Installing over-voltage and under voltage | **Discussion**<br>Guide students to identify ratings, trip curves, and terminal | **The students should be able to explain how to:**<br>• Select tools, equipment | Over- voltage and under voltage protective devices | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The | The following tools, safety gear and equipment are to be available:<br>• Set of spanners.<br>• Set of semi insulated | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | protective devices. | connections over-voltage and under voltage protective devices<br>**Demonstration**<br>Show students how to properly mount and wire fuses and circuit breakers.<br><br>**Practice**<br>Provide students with over- voltage and under voltage protective devices to practice its installation | and materials required.<br>• Interpret single line and lay out drawings.<br>• Install over-voltage and under voltage protective devices<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear. | installed as per IET regulations | students should explain how to install over- voltage and under voltage protective devices<br><br>**Principles:** The students should follow the correct procedures how to install over- voltage and under voltage protective devices<br><br>**Theories:** The students should explain:<br>• Operation of over- voltage and under voltage protective devices<br>• IET regulation | screw drivers.<br>• Analogue and digital multimeter.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Safety plastic and leather gloves.<br>• Overall.<br>• Combination pliers.<br>• Long nose s.<br>• Side cutter pliers.<br>• Spirit level. | |
| | 2.3 Installing fire detection and alarm system | (a) Installing fire detecting and warning systems. | **Discussion**<br>Guide students to discuss physical components, their features, and connection fire detecting and warning systems | The students should be able to explain how to:<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Install fire | Fire detection and warning system is installed as per regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to install fire detector and alarm system devices. | The following tools, equipment and safety gear should be available: -<br>• Installation manual<br>• Electrician's tool kit<br>• Multimeter<br>• Hammer<br>• Spirit level<br>• Flash light<br>• Hydrometer | 24 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | **Demonstration**<br>Show students how to mount detectors and connecting them to an alarm panel<br><br>**Practice**<br>Provide students with tools and materials to practice mounting and wiring detecting and warning systems | detecting and warning systems.<br>• Tests fire detecting and warning systems.<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | | **Principles:** The students should follow steps for Installing fire detecting and warning systems<br>**Theories:** The students should explain;<br>• Four stages of fire.<br>• Four classes of fire.<br>• Fire triangle.<br>• Purpose of fire alarm systems. | • Files<br>• Blower<br>• Vacuum cleaner<br>• Sets of spanners<br>• Overalls<br>• Safety boots<br>• Hand gloves<br>• Safety goggles | |
| | | (b) Installing intrusion detecting systems | **Description**<br>Guide the students to describe function and importance of IDS in building security<br><br>**Demonstrate**<br>Show students how to connect detectors to monitoring system<br><br>**Practice**<br>Provide students | The students should be able to explain how to:<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Install intrusion detecting systems Tests intrusion detecting systems<br>• Observe | Intrusion detecting systems is installed as per regulations. | **Method used:** The students should explain how to install intrusion detecting systems<br><br>**Principles:** The students should explain the how to install and commission intrusion detecting systems<br><br>**Theories.** The students should be able to explain: | The following tools, equipment and safety gear should be available: -<br>• Installation manual<br>• Electrician's tool kit<br>• Multimeter<br>• Hammer<br>• Spirit level<br>• Flash light<br>• Hydrometer<br>• Files<br>• Blower<br>• Vacuum cleaner<br>• Sets of spannerss<br>• Overalls<br>• Safety boots | |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | with IDS to practice its installation | safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | | • Components of intrusion circuit<br>• Location of intrusion circuit<br>• Application of intrusion circuit | • Hand gloves<br>• Safety goggles | |
| | | (c) Installing electric fence | **Discussion**<br>Guide students to discuss types of energizers and their uses of electric fence<br>**Demonstration**<br>Show students step-by-step how to choose a location, wiring and energizing of electric fence<br><br>**Practice**<br>Provide students with tools and materials to practice electric fence installation | **The students should be able to explain how to**:<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Install electric fence<br>• Tests electric fence<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | Electric fence is installed as per regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used:**<br>The students should explain how to install electric fence<br>**Principles:**<br>The students should be able to demonstrate the correct procedures and techniques for installing an electric fence and ensuring adherence to safety protocols.<br>**Theory:**<br>The students should be able to explain:<br>• Operation of electric fence<br>• Installation procedure<br>• IET regulation | The following tools, equipment and safety gear should be available: -<br>• Installation manual<br>• Electrician's tool kit<br>• Multimeter<br>• Hammer<br>• Spirit level<br>• Flash light<br>• Hydrometer<br>• Files<br>• Blower<br>• Vacuum cleaner<br>• Sets of spanners<br>• Overalls<br>• Safety boots<br>• Hand gloves<br>• Safety goggles | |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | (d) Installing security and video surveillanc e systems (CCTV). | **Discussion**<br>Guide students to discuss various types of CCTV cameras and their functionalities<br><br>**Demonstration**<br>Show students how to<br>• Mount different types of cameras<br>• set up a DVR/NVR, configure storage, and set recording schedules<br>**Practice**<br>Provide students with tools and materials to practice installation of CCTV camera | **The students should be able to explain how to**:<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Install security and video surveillance systems (CCTV).<br>• Tests security and video surveillance systems (CCTV).<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | Security and video surveillance systems (CCTV) are installed as per regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to install security and video surveillance systems (CCTV).<br><br>**Principles:** The students should explain the correct procedures how to install and commission security and video surveillance systems (CCTV).<br><br>**Theory:** The students should be able to explain:<br>• Operation of security and video surveillance system<br>• IET regulations | The following tools, equipment and safety gear should be available: -<br>• Installation manual<br>• Electrician's tool kit<br>• Multimeter<br>• Hammer<br>• Spirit level<br>• Flash light<br>• Hydrometer<br>• Files<br>• Blower<br>• Vacuum cleaner<br>• Sets of spanners<br>• Overalls<br>• Safety boots<br>• Hand gloves<br>• Safety goggles | |
| 3.0 Installing solar PV systems | 3.1 Handling solar PV array | (a) Connectin g cells to form solar PV panel | **Description**<br>Guide the students to Describe how | **The students should be able to explain how to:**<br>• Select tools, | cells are connected to form solar PV as per | **Knowledge evidence:**<br>**Detailed knowledge of:** | The following tools, safety gear and equipment are to be available:<br>• Combination pliers. | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | solar panels are made by connecting multiple solar cells<br><br>**Demonstration**<br>Show students how to connect two or more solar cells in series by joining the positive terminal of one cell to the negative terminal of the next cell.<br>Practice<br>Provide students with materials and tools to practice cells connections | • equipment and materials required.<br>• Interpret drawings.<br>• Connect cells to form solar PV panel<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | requirements | **Methods used**<br>The students should explain how to connect cells in series/parallel to form solar PV<br><br>**Principles:** The students should explain how solar cells are connected together to form solar PV panel<br><br>**Theory**:<br>The students should be able to explain:<br>• Principles of photo-voltaic energy conversion<br>• Blocking diode<br>• Bypass diode | • Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Multimeters.<br>• Soldering gun<br>• Cable cutter.<br>• Wire striper.<br>• Inclinometer<br>• Compass<br>• Pyranometer<br>• Overalls.<br>• Safety boots.<br>• Safety goggles. | |
| | | (b) Connecting solar PV in series to form string | **Description**<br>Guide the students to Describe how string is made by connecting multiple solar cells in series<br><br>**Demonstration** | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Interpret the information | Solar PV are connected in series as per requirements | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used** The students should explain how to connect solar PV in series to form string<br><br>**Principles:** The | The following tools and equipment should be available:<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Multimeters.<br>• Soldering gun<br>• Cable cutter.<br>• Wire striper. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | Show students how to connect two or more solar PV panel in series<br><br>**Practice**<br>Provide students with materials and tools to practice connections solar PV in series | on name plate of the panel<br>• Connect solar PV panel in series<br>• Measure Voltage and current<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | | students should state procedures of connecting solar PV in series:<br><br>**Theories:** the students should be able to explain:<br>• Meaning of string and array<br>• Measure voltage and current<br>• Panel Name plate data | • Inclinometer<br>• Compass<br>• Pyranometer<br>• Overalls.<br>• Safety boots.<br>• Safety goggles. | |
| | | (c) connecting solar PV in parallel | **Description**<br>Guide the students to discuss importance of connecting solar PV in parallel<br><br>**Demonstration**<br>Show students how to connect two or more solar PV panel in parallel<br><br>**Practice** | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Interpret the information on name plate of the panel<br>• Connect solar PV panel in parallel<br>• Measure | Solar PV are connected in parallel as per requirements | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to connect solar PV parallel<br><br>**Principle:** The students should be able to state the correct procedures of connecting solar PV in parallel | The following tools and equipment should be available:<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Multimeters.<br>• Soldering gun<br>• Cable cutter.<br>• Wire striper.<br>• Inclinometer<br>• Compass<br>• Pyranometer<br>• Overalls.<br>• Safety boots. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | Provide students with materials and tools to practice connections solar PV in in parallel | • Voltage and current<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | | **Theories:** the students should explain:<br>• Connection of solar PV in parallel<br>• Measurement of voltage and current | • Safety goggles. | |
| | | (d) Connecting solar PV in series-parallel | **Description**<br>Guide the students to discuss importance of connecting solar PV in series - parallel<br><br>**Demonstration**<br>Show students how to connect two or more solar PV panel in parallel<br><br>**Practice**<br>Provide students with materials and tools to practice connections solar PV in series-parallel | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Interpret the information on name plate of the panel<br>• Connect solar PV panel in parallel<br>• Measure Voltage and current<br>• Observe safety precautions<br>• Clean the | Solar PV are connected in series-parallel as per requirements | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to connect solar PV series-parallel<br><br>**Principle:** The students should be able to explain connection procedures of solar PV in series-parallel<br><br>**Theories:** The students should be able to explain:<br>• voltage and current | The following tools and equipment should be available:<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Multimeters.<br>• Soldering gun<br>• Cable cutter.<br>• Wire striper.<br>• Inclinometer<br>• Compass<br>• Pyranometer<br>• Overalls.<br>• Safety boots.<br>• Safety goggles. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | work area.<br>• Store tools, equipment and safety gear | | measurement<br>• Benefit of connecting solar PV panel in series-parallel | | |
| | 3.2 Installing solar electric system components | (a) Installing Solar panel (PV module) | **Discussion**<br>Guide the students to discuss effect of orientation, dust and shade in solar panel installation<br><br>**Demonstration**<br>Demonstrate step by step how to use solar specialize tools in installing solar PV<br><br>**Practice**<br>Provide students with tools and equipment to practice solar installation | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Select the correct sizes of cables as indicated by drawings.<br>• Install solar Panel<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | Solar panel is installed as per regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to install a solar panel<br><br>**Principles:** The students should explain procedures for installing of Solar Panel.<br><br>**Theories:** The students should state;<br>• Types of solar panels<br>• Effect of dust on solar PV panel<br>• Tilt angle and orientation<br>• Effect of shade | The following tools and equipment should be available:<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Multimeters.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Cable cutter.<br>• Junior hacksaw.<br>• Wire striper.<br>• Inclinometer<br>• Compass<br>• Pyranometer<br>• Overalls.<br>• Safety boots.<br>• Safety goggles. | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | • Proper location of solar PV installation<br>• Sizing of solar PV panel | | |
| | | (b) Installing charge controller | **Discussion**<br>Guide students to discuss the types of charge controllers and how they function in terms of managing the energy flow from solar panels to batteries.<br><br>**Demonstration**<br>Demonstrate how to connect the charge controller to a solar panel, battery bank, and load<br><br>**Practice**<br>Provide students with tools and equipment to practice installation of charge controller into a working solar power | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Select the correct sizes of cables as indicated by drawings.<br>• Install charge controller<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | Charge controller is installed as per regulations | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to install a charge controller<br><br>**Principles:**<br>Students should be able to follow the correct procedures and techniques for installing a charge controller<br><br>**Theories:** The students should explain;<br>• Types of charge controllers<br>• Sizing charge controller<br>• Location of charge controller<br>• Importance of | The following tools and equipment should be available:<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Multimeters.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Cable cutter.<br>• Junior hacksaw.<br>• Wire striper.<br>• Overalls.<br>• Safety boots.<br>• Safety goggles. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | system. | | | charge controller | | |
| | | (c) Installing batteries | **Discussion**<br>Guide students to discuss the purpose of batteries in solar power systems and their types.<br><br>**Demonstration**<br>Show students how to:<br>• Connect the batteries in series and parallel<br>• connect the battery bank to the charge controller and inverter<br>**Practice**<br>Provide students with a set of batteries and system specifications to practice batteries configuration. | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Select the correct sizes of cables as indicated by drawings.<br>• Install batteries<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | batteries is installed as per regulations | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to Install batteries as per requirement<br>**Principles:** The students should explain:<br>• Principles of charging and discharging of batteries<br>• Connection procedures of batteries in series and in parallel<br>**Theories:** The students should explain;<br>• Types of batteries<br>• Cycle use of batteries<br>• DoD, SoC and SoH<br>• Application of | The following tools and equipment should be available:<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Multimeters.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Cable cutter.<br>• Junior hacksaw.<br>• hydrometer<br>• Wire striper.<br>• Overalls.<br>• Safety boots.<br>• Safety goggles. | |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | | | | batteries in solar PV<br>• Sizing of batteries | | |
| | | (d) Installing inverters | **Discussion**<br>Guide the students to discuss different types of inverters and their specific applications<br>**Demonstration**<br>Show students how to<br>• Connect the DC input from the battery to inverter<br>• Connect the AC output to the load<br>**Practice**<br>Provide students with tools and equipment to practice connections of inverter in the systems | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required.<br>• Interpret drawings.<br>• Select the correct sizes of cables as indicated by drawings.<br>• Install inverters<br>• Observe safety precautions<br>• Clean the work area.<br>• Store tools, equipment and safety gear | Inverters is installed as per regulations | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to install an inverter<br><br>**Principles:** The students should state the correct procedures to install inverters<br><br>**Theories:** The students should explain;<br>• Types of inverters<br>• Importance of inverter<br>• Sizing of inverter | The following tools and equipment should be available:<br>• Combination pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Long nose pliers.<br>• Multimeters.<br>• Ball peen hammer.<br>• Cross peen hammer.<br>• Cable cutter.<br>• Junior hacksaw.<br>• hydrometer<br>• Wire striper.<br>• Overalls.<br>• Safety boots.<br>• Safety goggles. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | 3.3 Design PV solar power system | (a) Designing of solar PV DC system | **Visual Aids**<br>Guide students to visualize solar systems flowcharts or diagrams illustrating connection components<br><br>**Design Software**<br>Guide the students to computer software such as PVsyst, Helioscope, or basic spreadsheets to design solar DC system<br><br>**Practice**<br>Guide students to calculate energy requirements for a given scenario | **The students should be able to explain how to:**<br>• Estimate load requirement<br>• Size solar<br>• Size charge controller<br>• Size batteries<br>• Draw solar PV wiring system | PV solar power system is designed as per requirement | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to: Design PV solar power system<br><br>**Principles:** The students should explain steps to design the solar PV DC system<br><br>**Theory:** The students should explain:<br>• Solar PV DC system components<br>• Principles of load calculation | The following tools and equipment should be available:<br>• Note book<br>• Calculator<br>• Pen<br>• Pencil<br>• Computer software | 24 |
| | | (b) Design solar PV AC system | **Visual Aids**<br>Guide students to visualize solar systems flowcharts or diagrams illustrating connection | **The students should be able to explain how to:**<br>• Estimate load requirement<br>• Size solar<br>• Size charge controller | PV solar AC system is designed as per requirement | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to: Design solar PV AC | The following tools and equipment should be available:<br>• Note book<br>• Calculator<br>• Pen<br>• Pencil<br>• Computer software | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | components<br><br>**Design Software**<br>Guide the students to computer software such as PVsyst, Helioscope, or basic spreadsheets to design solar AC system<br><br>**Practice**<br>Guide students to calculate energy requirements for a given scenario | • Size batteries<br>• Size inverter<br>• Draw solar PV wiring system | | system<br><br>**Principles:** The students should explain procedures to design solar AC system<br><br>**Theory:** The students should be able to explain:<br>• Solar PV AC components<br>• Principles of load calculation | | |
| | 3.4 Constructing solar PV mounting structure | (a) Constructing rooftop solar PV mounting structure | **Discussion**<br>Guide the students to discuss purpose of mounting structures and their importance in system performance<br><br>**Visual Aid**<br>Guide the students to visualize image/video of rooftop mounting | **The students should be able to explain how to:**<br>• Select proper material (metal/treated timber)<br>• Select means of mounting (rooftop mounting)<br>• Measure the gap between the roof and the PV<br>• Fasten | Solar PV mounting structure is constructed as per regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to construct rooftop solar PV mounting structure<br><br>**Principles:** The students should state the correct procedures and technics to construct | The following tools, safety gear and equipment are to be available:<br>: -<br>• Set of screw drivers.<br>• Set of pliers.<br>• Solar panels<br>• Electrician knife.<br>• Measuring tape.<br>• Hacksaw<br>• Handsaw.<br>• Set of Hammers.<br>• Set of screw drivers.<br>• Drill machine.<br>• Welding machines | 16 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | structure<br><br>**Demonstration**<br>Show students how to<br>• Fabricate mounting structure<br>• Assemble a mounting structure using sample components<br>**Practice**<br>Provide students with components of mounting structure to practice assembling of mounting structure | structure support with robust material | | rooftop solar PV mounting structure<br><br>**Theories:** The students should explain: -<br>• Welding and fabrication methods.<br>• How to obtain proper tilt angle.<br>• Properties of solar mounting materials.<br>• Types of material used in solar mounting structures.<br>• Different types of solar mounting structures for laying PV arrays. | • Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | |
| | | (b) Constructing ground mount solar PV mounting structure | **Discussion**<br>Guide students to discuss purpose of ground-mount systems and their advantages over rooftop systems. | **The students should be able to explain how to:**<br>• Select proper material (metal/treated timber)<br>• Select means | Solar PV mounting structure is constructed as per regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to construct ground | The following tools, safety gear and equipment are to be available:<br>-<br>• Set of screw drivers.<br>• Set of pliers.<br>• Solar panels<br>• Electrician knife. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | **Visual Aids**<br>Guide students to visualize the image/video showing factors like land slope, orientation, tilt angle, and spacing<br><br>**Demonstration**<br>Show students how to<br>• assess and prepare the site for installation<br>• Assemble support frames and attach rails using sample components<br>**Practice**<br>Guide students in assembling a complete mounting structure and attaching panels | of mounting ground mounting<br>• Cast base support for ground mounted structure.<br>• Fasten structure support with robust material for roof top mounting. | | mount solar PV mounting structure:<br><br>**Principles:** The students should explain procedures how to construct ground mount solar PV mounting structure<br><br>**Theories:** the students should be able to explain<br>• Construction materials (civil work) Weld and fabricate.<br>• Constructing civil structure (casting of base)<br>• How to obtain proper tilt angle.<br>• Fabricating panel mounting structure | • Measuring tape.<br>• Hacksaw<br>• Handsaw.<br>• Set of Hammers.<br>• Set of screw drivers.<br>• Drill machine.<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | |
| | | | | | | | | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | (c) Constructing auto rotating solar PV mounting structure | **Discussion**<br>Discuss the component's function and importance of auto rotating solar PV mounting structure<br><br>**Demonstration**<br>Show students how to<br>• prepare and install a solid foundation<br>• install motors, gear, and sensors work together for rotation<br>**Practice**<br>Guide students in assembling the structure and attaching panels | **The students should be able to explain how to:**<br>• Select proper material (metal/treated timber)<br>• Select means of mounting auto solar tracking<br>• Fasten structure support with robust material for roof top mounting. | Solar PV mounting structure is constructed as per regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to construct auto rotating solar PV mounting structure:<br><br>**Principles:** The students should explain procedures how to construct auto rotating solar PV mounting structure<br><br>**Theories**: The students should be able to explain:<br>• Components of solar tracking system<br>• Operation of solar tracking system<br>• Importance solar tracking system | The following tools, safety gear and equipment are to be available:<br>: -<br>• Set of screw drivers.<br>• Set of pliers.<br>• Solar panels<br>• Electrician knife.<br>• Measuring tape.<br>• Hacksaw<br>• Handsaw.<br>• Set of Hammers.<br>• Set of screw drivers.<br>• Drill machine.<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles. | |
| 4.0 Installing | 4.1 Installing | (a) Installing | | | | | | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| solar thermal systems | solar water heater | Flat plate collector solar water heater | **Description**<br>Guide students to<br>• Discuss the purpose and advantages of flat plate collector systems<br>• Calculate the system size based on household needs.<br>**Demonstration**<br>Show students how to<br>• assemble a model or actual components<br>• test the system for leaks, flow, and heating performance<br>**Practice**<br>Provide students with components to practice assembling and installing the system | **The students should be able to explain how to:**<br>• Choose proper Installation angle (inclination angle).<br>• Make a solar heater supporting structure.<br>• Install Flat plate collector solar water heater<br>• Select proper plumbing tools and equipment.<br>• Test the system. | Solar heater is installed as per requirements. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to install Flat plate collector solar water heater<br><br>**Principles:** The students should explain procedures how to install Flat plate collector solar water heater<br><br>**Theories:** The students should explain: -<br>• Classification of solar water heater based on installation practices.<br>• Recommended installation clearance between collector banks.<br>• Difference between cold water and hot | The following tools, safety gear and equipment are to be available:<br>• Solar panels<br>• Compass<br>• inclinometer<br>• Set of screw drivers.<br>• Set of pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Hacksaw<br>• Handsaw.<br>• Set of Hammers.<br>• Drill machine.<br>• Analog/digital Multimeter<br>• Grinders<br>• Welding machine.<br>• Set of Cordless power tools.<br>• Spirit level<br>• Fish tape<br>• Blanket/cardboard/black plastic<br>• Conduit bender<br>• Set of Wrenches<br>• Pipe cutter<br>• Set of PPEs | 24 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | water plumbing systems<br>• Collector orientation and angle of tilt. | | |
| | | (b) Installing evacuated tube collector solar water heater | **Description**<br>Guide students to<br>• Discuss the purpose and advantages of evacuated tube collector systems<br>• Calculate the system size based on household needs.<br>**Demonstration**<br>Show students how to<br>• assemble a model or actual components<br>• test the system for leaks, flow, and heating performance<br>**Practice**<br>Provide students with components to practice | **The students should be able to explain how to:**<br>• Choose proper Installation angle (inclination angle).<br>• Make a solar heater supporting structure.<br>• Install evacuated tube collector solar water heater<br>• Select proper plumbing tools and equipment.<br>• Test the system. | Solar heater installed as per recommended standards and procedures. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to install evacuated tube solar water heater collector<br><br>**Principles:** The students should explain procedures how to install evacuated tube collector solar water heater<br><br>**Theories:** the students should be able to explain:<br>• Installation Evacuated tube collector solar water heater<br>• Application of Evacuated tube collector solar | The following tools, equipment and safety gear should be available: -<br>• Solar panels<br>• Compass<br>• inclinometer<br>• Set of screw drivers.<br>• Set of pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Hacksaw<br>• Handsaw.<br>• Set of Hammers.<br>• Drill machine.<br>• Grinders<br>• Welding machine.<br>• Set of Cordless power tools.<br>• Spirit level<br>• Fish tape<br>• Blanket/cardboard/black plastic<br>• Conduit bender<br>• Set of Wrenches<br>• Pipe cutter<br>• Set of PPEs | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | assembling and installing the system | | | water heater | | |
| | | (c) Installing heat pump for system solar water heater | **Description**<br>Guide students to<br>• Discuss the purpose and advantages of heat pump for system solar water heater<br>• Calculate the system size based on the needs.<br>**Demonstration**<br>Show students how to<br>• assemble a model or actual components<br>• test the system for leaks, flow, and heating performance<br>**Practice**<br>Provide students with components to practice assembling and installing the system | **The students should be able to explain how to:**<br>• Choose proper Installation angle (inclination angle).<br>• Select proper plumbing tools and equipment.<br>• Install heat pump system for solar water heater<br>• Test the system. | Solar heater is installed as per requirement. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should be able to explain how to Install heat pump for system solar water heater<br><br>**Principles:** The students should explain how to Install heat pump for system solar water heater<br>Theories: the students should be able to explain:<br>• Heat pump solar heater applications.<br>• Plumbing tools and their application.<br>• heat pump for system solar water heater installation. | The following tools, safety gear and equipment are to be available:<br>• Solar panels<br>• Compass<br>• inclinometer<br>• Set of screw drivers.<br>• Set of pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Hacksaw<br>• Handsaw.<br>• Set of Hammers.<br>• Drill machine.<br>• Multimeter<br>• Grinders<br>• Welding machine.<br>• Set of Cordless power tools.<br>• Spirit level<br>• Fish tape<br>• Blanket/cardboard/black plastic<br>• Conduit bender<br>• Set of Wrenches<br>• Pipe cutter<br>• Set of PPEs | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | 4.2 Installing solar water pump | (a) Installing Surface Solar Water pump system | **Discussion**<br>Guide the students to discuss the purpose and benefits of surface solar water pump systems<br><br>**Visual Aids**<br>Guide the students to visualize components and their assembly process<br><br>**Demonstration**<br>Show students how to connect solar panels, the controller, and the pump<br>Practice<br>Provide the students with components and tools to practice system installation | **The students should be able to explain how to:**<br>• Perform water table measurement<br>• Identify the requirement<br>• Calculate daily water requirement<br>• Size water systems<br>• Install solar water pumping system<br>• Observe safety precaution<br>• Clean tools and equipment<br>• Store tools and equipment | Solar water pump installed as per recommended standards and procedures | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should able to explain how to install Surface Solar Water pump system<br><br>**Principles:** The students should explain procedures how install Surface Solar Water pump system<br><br>**Theories:** The students should explain: -<br>• Types of water pumps<br>• Basics of solar water pumping<br>• Applications of solar water pumping<br>• Sizing & Designing a Solar Water Pumping System.<br>• Solar water pumping | The following tools, equipment and safety gear should be available: -<br>• Solar panels<br>• Compass<br>• inclinometer<br>• Set of screw drivers.<br>• Set of pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Hacksaw<br>• Handsaw.<br>• Set of Hammers.<br>• Set of screw drivers.<br>• Drill machine.<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles.<br>• Analog/digital Multimeter<br>• Grinders<br>• Welding machine.<br>• Set of Cordless power tools.<br>• Generator<br>• PV combiner box<br>• Charger controller<br>• Inverter<br>• Batteries and battery cage.<br>• Fuse boxes<br>• Distribution board. | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | applications<br>• The main components of a solar water pumping system<br>• The steps in the process of specifying solar water pumping system. | • Spirit level<br>• Fish tape<br>• Blanket/cardboard/black plastic<br>• Conduit bender | |
| | | (b) Installing Submersible Solar Water pump system | **Discussion**<br>Guide the students to discuss the purpose and benefits of Submersible Solar Water pump system<br>**Visual Aids**<br>Guide the students to visualize components and their assembly process<br><br>**Demonstration**<br>Show students how to connect solar panels, the controller, and the pump | **The students should be able to explain how to:**<br>• Perform water table measurement<br>• Identify the requirement<br>• Calculate daily water requirement<br>• Size water systems<br>• Install solar water pumping system | Solar water pump installed as per recommended standards and procedures | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to install Surface Solar Water pump system<br><br>**Principles:** The students should explain procedures how to install Surface Solar Water pump system.<br><br>**Theories:** The students should explain: -<br>• Operation of submersible pumps | The following tools, safety gear and equipment are to be available:<br>: -<br>• Solar panels<br>• Compass<br>• inclinometer<br>• Set of screw drivers.<br>• Set of pliers.<br>• Electrician knife.<br>• Measuring tape.<br>• Hacksaw<br>• Handsaw.<br>• Set of Hammers.<br>• Set of screw drivers.<br>• Drill machine.<br>• Leather gloves.<br>• Overall.<br>• Safety boots.<br>• Safety goggles.<br>• Analog/digital Multimeter | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | **Practice**<br>Provide the students with components and tools to practice system installation | | | • Calculation of head<br>• Sizing & Designing a Solar Water Pumping System. | • Grinders<br>• Welding machine.<br>• Set of Cordless power tools.<br>• Generator<br>• PV combiner box<br>• Charger controller<br>• Inverter<br>• Batteries and battery cage.<br>• Fuse boxes<br>• Distribution board.<br>• Spirit level<br>• Fish tape<br>• Blanket/cardboard/black plastic<br>• Conduit bender | |
| 5.0 Constructing solar PV power mini grid | 5.1 Constructing electrical distribution lines | (a) Erecting LV pole | **Discussion**<br>Guide the students to discuss the role of LV poles in the power distribution network.<br><br>**Demonstration**<br>Show students how to<br>• Inspect and prepare the pole for installation<br>• use equipment | **The students should be able to explain how to:**<br>• Make preparation for LV distribution line installation<br>• Interpret drawing<br>• Erect pole vertically | LV pole is Erected as per I.E.E regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br><br>**Methods used**: The students should be able explain how to erect LV pole<br><br>**Principles:** The students should explain how to erect LV poles<br><br>**Theories:** The | The following tools, safety gear and equipment are to be available:<br>• First aid kit<br>• Occupational Safety and Health Agents(OSHA) rules and regulations<br>• Ladders<br>• Fire extinguishers<br>• Hole<br>• Set of pliers<br>• Set of screw drivers<br>• Set of wrenches.<br>• Electrician knife<br>• Climbing irons and | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | and tools to lift and position the pole | | | students should explain: -<br>• Height of LV pole<br>• Materials for LV poles<br>• Treatment of wooden poles<br>• Span between two LV poles | calf pads.<br>• Pole erecting sheerleg<br>• Stay wire dispenser<br>• Set of PPEs | |
| | | (b) Mounting necessary components on LV pole | **Discussion**<br>Guide the students to discuss the necessary components on LV pole in the power distribution network.<br><br>**Demonstration**<br>Show students how to use equipment and tools to install components on LV pole<br><br>**Study tour**<br>Arrange tour for students to visit distribution networks | **The students should be able to explain how to:**<br>• Make preparation for LV distribution line installation<br>• Interpret drawing<br>• mount distribution line requirements | A necessary component on LV pole is mounted as per I.E.E regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain mount necessary components on LV pole<br><br>**Principles:** The students should explain steps how to mount necessary components on LV pole.<br><br>**Theories:** The students should explain: -<br>• The meaning of low/medium voltage. | The following tools, safety gear and equipment are to be available:<br>-<br>• First aid kit<br>• Occupational Safety and Health Agents(OSHA) rules and regulations<br>• Ladders<br>• Fire extinguishers<br>• Hole<br>• Set of pliers<br>• Set of screw drivers<br>• Set of wrenches.<br>• Electrician knife<br>• Climbing irons and calf pads.<br>• Pole erecting sheerleg<br>• Stay wire dispenser<br>• Set of PPEs | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | | | | • Types of insulators and their application.<br>• Types of cables used in distribution lines.<br>• Distribution substation and centers.<br>• Feeder circuits and service lines. | | |
| | 5.2 Installing distribution transformer | (a) Installing transformer to distribution network | **Discussion**<br>Guide the students to discuss principle of operation of transformer<br><br>**Demonstration**<br>Show students how to prepare mounting structure for installing transformer<br><br>**Visual Aids**<br>Guide students to visualize a video which shows installation of | **The students should be able to explain how to:**<br>• Prepare tools, equipment and materials<br>• Interpret drawings<br>• Install distribution Transformer<br>• Energize transformer | Transformer is installed to distribution network as per regulations. | **Knowledge evidence: Detailed knowledge of: Methods used**: The students should be able to explain how to install transformer to distribution network<br><br>**Principles:** The students should be able to state how to install transformer to distribution network<br><br>**Theories:** The students should | The following tools, safety gear and equipment are to be available:<br>• First aid kit<br>• Occupational Safety and Health Agents (OSHA) rules and regulations<br>• Ladders<br>• Fire extinguishers<br>• Set of pliers<br>• Set of screw drivers<br>• Set of wrenches.<br>• Electrician knife<br>• Climbing irons and calf pads.<br>• Set of PPEs | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | distribution transformer<br><br>**Study tour**<br>Arrange tour for students to visit installed distribution transformer | | | explain: -<br>• Construction of transformer<br>• Types of transformers<br>• Types of tests carried out in distribution transformers.<br>• Types of transformers mounting structures.<br>• Ratings of the transformer.<br>• Cooling methods of transformer.<br>• Losses and how to minimize them. | | |
| | | (b) Installing protective device to distribution transformer | **Discussion**<br>Guide the students to discuss the importance of protective devices for transformers<br><br>**Demonstration**<br>Show students how to<br>• Inspect a | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required<br>• Install transformer protective systems (Neutral | Distribution transformer is installed as per recommended standards and regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should able to explain how to install protective device to distribution transformer network | The following tools, safety gear and equipment are to be available:<br>: -<br>• First aid kit<br>• Occupational Safety and Health Agents (OSHA) rules and regulations<br>• Ladders<br>• Fire extinguishers<br>• Set of pliers | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | transformer and its accessories before installation.<br>• install fuses, circuit breakers, and surge arresters<br>• test the functionality of installed protective devices.<br>**Study tour**<br>Arrange tour for students to visit installed distribution transformer | Earthing, Metal plate earthing, Buchholz relay, drop out fuse, LV fuse)<br>• Check cooling system of the distribution Transformer | | **Principle:** the students should be able explain how to install protective device to distribution transformer network<br><br>**Theories:** The students should explain: -<br>• Drop out fuse installation<br>• Cartridge fuses installation.<br>• Operation of Buchholz relay<br>• Surge arrester | • Set of screw drivers<br>• Set of wrenches.<br>• Electrician knife<br>• Climbing irons and calf pads.<br>• Set of PPEs | |
| | 5.3 Installing electrical service lines | (a) Connecting power supply to the consumer premises | **Demonstration**<br>Show students how to connect power supply to new installation<br><br>**Study tour**<br>Arrange tour for students to visit installed | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required<br>• Interpret electrical drawing<br>• Connect | power supply is connected to the consumer premises as per I.E.E regulations | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to connect power supply to the consumer premises<br><br>**Principles:** The | The following tools, safety gear and equipment are to be available:<br>• First aid kit<br>• Occupational Safety and Health Agents (OSHA) rules and regulations<br>• Ladders<br>• Fire extinguishers<br>• Masks | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | connection of electricity to customers premisses | consumer premises to utility network (bracket, service line, tail cable)<br>• Verify the connections | | students should explain procedure to follow how to connect power supply to the consumer premises .<br>**Theories:** The students should explain: -<br>• Types of wires, size and insulation.<br>• Proper cable/wire termination methods.<br>• IET regulations and Local regulation governing supply<br>• Earthing and testing procedures. | • Ear muffs<br>• Helmets<br>• Overalls<br>• Hand gloves<br>• Safety glasses<br>• Safety boots | |
| | | (b) Installing energy meter | **Demonstration**<br>Show students how to install energy meter<br><br>**Study tour**<br>Arrange study tour for students to visit Utility | **The students should be able to explain how to:**<br>• Select tools, equipment and materials required<br>• Interpret electrical | power supply is connected to the consumer premises as per IET regulations | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should be able to explain install energy meter | The following tools, safety gear and equipment are to be available:<br>: -<br>• First aid kit<br>• Occupational Safety and Health Agents (OSHA) rules and regulations | |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | company (TANESCO) to learn different types of tariffs | drawing<br>• Install energy meter to consumer premises<br>• Verify the connections | | **Principles:** The students should explain process to install energy meter<br><br>**Theories:** the students should be able to explain<br>• Operation of energy meter<br>• Calculation of electrical unit<br>• Type of Tarriff applied in Tanzania<br>• Net metering | • Ladders<br>• Fire extinguishers<br>• Masks<br>• Ear muffs<br>• Helmets<br>• Overalls<br>• Hand gloves<br>• Safety glasses<br>• Safety boots | |
| 6.0 Performing maintenance of electrical systems | 6.1 Carrying out preventive maintenance | (a) Carrying out mechanical inspection. | **Discussion**<br>Guide the students to discuss the significance of mechanical inspections<br>**Demonstration**<br>Show students how to<br>• Use measuring and testing tools.<br>• Inspect common machine | **The students should be able to explain how to:**<br>• Carry out visual and thoroughly inspection to locate the defective area for mechanical system. | Mechanical inspection Carried out as per regulation. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to carryout mechanical inspection.<br>.<br>**Principles:** The students should explain procedures how to carryout mechanical inspection.<br><br>**Theories:** The | The following tools, safety gear and equipment are to be available:<br>• Electrical tool box.<br>• Megger.<br>• multimeter.<br>• Insulation tester.<br>• Safety boots.<br>• Hand gloves.<br>• Safety glasses<br>• Overall. | 8 |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | parts<br>**Practice**<br>Guide the students to practice the inspection of the machines | | | students should explain importance of visual inspection mechanical systems | | |
| | | (b) Carrying out electrical inspection. | **Discussion**<br>Guide the students to discuss the significance of electrical inspections<br>**Demonstration**<br>Show students how to<br>• Use measuring and testing tools.<br>• Inspect common machine parts<br><br>**Practice**<br>Guide the students to practice the inspection electrical systems | **The students should be able to explain how to:**<br>• Carry out visual and thoroughly inspection to locate the defective area for electrical system. | Electrical inspection Carried out as per regulation. | **Knowledge evidence: Detailed knowledge of: Methods used**: The students should explain how to carryout mechanical inspection.<br>.<br>**Principles:** The students should explain steps to be taken when carryout mechanical inspection<br><br>**Theories:** The students should explain Importance of visual inspection electrical systems | The following tools, safety gear and equipment are to be available:<br>• Electrical tool box.<br>• Megger.<br>• multimeter.<br>• Insulation tester.<br>• Safety boots.<br>• Hand gloves.<br>• Safety glasses<br>• Overall. | |
| | | (c) Carrying out remedial action. | **Discussion**<br>Guide the students to discuss the role of remedial actions | **The students should be able to explain how to:**<br>• Select tools, equipment | Remedial service is Carried out as per regulation. | **Knowledge evidence: Detailed knowledge of: Methods used**: | The following tools, safety gear and equipment are to be available:<br>• Electrical tool box.<br>• Megger. | |

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| | | | | Process Assessment | Product/Service s Assessment | Knowledge Assessment | | |
| | | | in maintenance and repair.<br><br>**Demonstration**<br>Show students how to<br>• use tools and methods to identify faults<br>• replace a faulty component or recalibrate a system<br>• prepare detailed remedial action reports<br>**Practice**<br>Guide the students to practice using diagnostic and repair tools. | and materials required<br>• Carry remedial service as machine manual<br>• Test machine<br>• Clean working area<br>• Store tools, equipment and material | | The students should explain how to carry remedial service<br>.<br>**Principles:** The students should explain how to carry out remedial service machine by using service manual<br><br>**Theories:** The students should explain importance of remedial service | • multimeter.<br>• Insulation tester.<br>• Safety boots.<br>• Hand gloves.<br>• Safety glasses<br>• Overall.<br>• Service Manual | |
| | | (d) Preparing schedules of preventive maintenance for each machinery | **Discussion**<br>Guide students to discuss<br>• The importance of preventive maintenance.<br>• The consequences of neglecting | **The students should be able to explain how to:**<br>• Identify parts of the machine<br>• Prepare parts according to service manual | Electrical inspection Carried out as per regulation. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to prepare schedules of preventive maintenance for | The following tools, safety gear and equipment are to be available:<br>• Electrical tool box.<br>• Megger.<br>• multimeter.<br>• Insulation tester.<br>• Safety boots.<br>• Hand gloves.<br>• Safety glasses | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | scheduled maintenance.<br>**Demonstration**<br>Show students how to<br>• use software or templates to create schedules<br>• extracting maintenance recommendations from manuals<br>• develop a preventive maintenance plan.<br>**Practice**<br>Guide the students to practice maintenance schedule prepare | • Prepare service card<br>• Prepare machine's logbook<br>• Prepare preventive maintenance schedule | | each machinery .<br>**Principles:** The students should explain methods how to prepare schedules of preventive maintenance for each machinery<br><br>**Theories:** The students should explain:<br>• Importance of preventive maintenance for each machinery<br>• Prepare preventive maintenance schedule | • Overall. | |
| | | (e) Perform preventive maintenance | **Discussion**<br>Guide the students to discuss<br>• the role of PM in maintenance strategies.<br>• The consequences | **The students should be able to explain how to:**<br>• Select tools, equipment and materials as per preventive maintenance schedule | preventive maintenance is performing as per instructional manual | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to perform preventive maintenance . | The following tools, safety gear and equipment are to be available:<br>• Electrical tool box.<br>• Megger.<br>• multimeter.<br>• Insulation tester.<br>• Safety boots.<br>• Hand gloves. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | | of neglecting PM.<br>**Demonstration**<br>Show students how to<br>• Lubricate, tight, and clean on a mock or real machine.<br>• inspect for wear and use diagnostic tools<br>**Practice**<br>Guide the students to identify wear, damage, or corrosion in the systems | • Monitor the condition of the machine performance periodically<br>• Perform preventive maintenance according service manual | | **Principles:**<br>The students should be able to demonstrate the correct procedures for performing preventive maintenance<br><br>**Theories:**<br>The students should explain:<br>• Types and importance of preventive maintenance.<br>• Methods and tools used in preventive maintenance.<br>• Relevant regulations and safety measures | • Safety glasses<br>• Overall.<br>• Service Manual | |
| | 6.2 Carrying out corrective maintenance | (a) Carrying out corrective maintenan | **Discussion**<br>Guide the students to discuss | **The students should be able to explain how to:**<br>• Carry out | Corrective maintenance in mechanical systems of the | **Knowledge evidence:**<br>**Detailed knowledge of:** | The following tools, safety gear and equipment are to be available:<br>• Electrical tool box. | 16 |

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|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | ce in mechanical systems of the machine. | • Common mechanical faults and their causes.<br>• Corrective maintenance workflow.<br>**Demonstration**<br>Show students how to<br>• Identify faults using inspection and diagnostic tools.<br>• Replace a bearing or aligning shafts.<br>**Practice**<br>Provide students with tools and materials to practice corrective maintenance | visual and thoroughly inspection to locate the defective area.<br>• Rectify the identified fault.<br>• Carry out test.<br>• Observe safety precautions<br>• Clean the work area.<br>• Collect tools, equipment and other items for storage. | machine is carried out according to maintenance instruction manual. | **Methods used**:<br>The students should explain how to carry out corrective maintenance.<br><br>**Principles:**<br>The students should explain procedures how to Carry out corrective maintenance.<br><br>**Theories:** The students should explain:<br>• The term corrective maintenance.<br>• The maintenance schedule.<br>• The meaning of record keeping, history cards and history register. | • Megger.<br>• Analogue and digital multimeter.<br>• Insulation tester.<br>• Safety boots.<br>• Hand gloves.<br>• Safety glasses.<br>• Overall.<br>• Clamp-on meter.<br>• Relay test set. | |
| | | (b) Carrying out corrective maintenance in | **Discussion**<br>Guide the students to discuss<br>• Common | **The students should be able to explain how to:**<br>• Interpret electrical | Corrective maintenance implemented according to maintenance | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: | The following tools, safety gear and equipment are to be available:<br>• Electrical tool box.<br>• Megger. | |

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| | | | | Process Assessment | Product/Services Assessment | Knowledge Assessment | | |
| | | electrical systems of the machine | electrical faults and their causes.<br>• Corrective maintenance workflow.<br>**Demonstration**<br>Show students how to<br>• Identify faults using inspection and diagnostic tools.<br>• Replace a faulty part in electrical systems.<br>**Practice**<br>Provide students with tools and materials to practice corrective maintenance | diagram.<br>• Perform troubleshooting<br>• Rectify the identified fault.<br>• Carry out test.<br>• Observe safety precautions<br>• Clean the work area.<br>• Collect tools, equipment and other items for storage. | instruction manual | The students should explain how to carry out corrective maintenance.<br><br>**Principles:**<br>The students should explain the principles or procedures of:<br>Carrying out corrective maintenance.<br><br>**Theories:** The students should explain:<br>• Troubleshooting to electrical systems<br>• Record keeping of maintenance | • multimeter.<br>• Insulation tester.<br>• Safety boots.<br>• Hand gloves.<br>• Safety glasses.<br>• Overall.<br>• Clamp-on meter.<br>• Relay test set. | |

## Form Four

**Table 6:** *Detailed Contents for Form Four*

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| 1.0 Installing electrical machines | 1.1 Installing AC machines | (a) Installing induction motors. | **Discussion**<br>Guide the students to discuss<br>• Induction motors and their applications.<br>• installation challenges and safety considerations<br>**Demonstration**<br>Show students<br>• the key parts of an induction motor and their functions.<br>• The procedure of installing the induction machine | **The students should be able to explain how to:**<br>• Interpret the installation diagram.<br>• Select tools, equipment and materials.<br>• Construct the machine base<br>• Install AC machine.<br>• Test AC machine vibration and alignment.<br>• Observe safety precautions<br>• Clean the work area.<br>• Collect tools, equipment and other items for storage. | Induction motors is installed as per installation guideline | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**<br>The students should explain how to install induction motors<br>**Principles:** The students should explain the principles of:<br>• Operation of single and three phases A.C. motor.<br>• Testing of single and three phase A.C. machines.<br>**Theories:** The students should explain:<br>• Magnetism and characteristic of magnet.<br>• Law of magnetism.<br>• Electro magnetism.<br>• Construction of AC machines. | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs.<br>• A set of screw drivers.<br>• A set of spanners.<br>• Ball pein hammer.<br>• Cross pein hammer.<br>• Megger.<br>• Combination plier.<br>• Diagonal cutting plier.<br>• Electrician knife.<br>• Safety goggles.<br>• Overall.<br>• Safety boots.<br>• Installation tester.<br>• Digital multimeter.<br>• Analogue multimeter.<br>• Clamp on meter.<br>• Gloves. | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | • Testing of insulation resistance and verification of all connections<br>**Practice**<br>Guide the students to practice installation of induction motor | | | • Difference of single phase and three phase A.C. machines.<br>• Application of single and three phase A.C. machines. | | |
| | | (b) Installing synchronous motors. | **Discussion**<br>Guide the students to discuss<br>• synchronous motors and their applications.<br>• installation challenges and safety considerations<br>**Demonstration**<br>Show students<br>• the key parts of an synchronous motor and their | **The students should be able to explain how to:**<br>• Interpret the installation diagram.<br>• Select tools, equipment and materials.<br>• Construct the machine base<br>• Install synchronous motors.<br>• Test synchronous motors vibration and alignment.<br>• observe safety precautions | synchronous motors.is installed as per installation guideline | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to: install synchronous motors.<br>**Principles:** The students should explain the principles of:<br>• Operation of synchronous motors.<br>• Testing of synchronous motors.<br>**Theories:** The students should explain: | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs.<br>• A set of screw drivers.<br>• A set of spanners.<br>• Ball pein hammer.<br>• Cross pein hammer.<br>• Megger.<br>• Combination plier.<br>• Diagonal cutting plier.<br>• Electrician knife.<br>• Safety goggles.<br>• Overall.<br>• Safety boots.<br>• Installation tester. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | functions.<br>• The procedure of installing the induction machine<br>• Testing of insulation resistance and verification of all connections<br>**Practice**<br>Guide the students to practice installation of synchronous motor | • Clean the work area.<br>• Collect tools, equipment and other items for storage. | | • Magnetism and characteristic of magnet.<br>• Law of magnetism.<br>• Electro magnetism.<br>• Construction of synchronous motors.<br>• Application of synchronous motors. | • Digital multimeter.<br>• Analogue multimeter.<br>• Clamp on meter.<br>• Gloves. | |
| | | (c) Installing generators. | **Discussion**<br>Guide the students to discuss<br>• The purpose and applications of generators<br>• key component of the generator and their functions.<br>**Visual Aid** | **The students should be able to explain how to:**<br>• Interpret the installation diagram.<br>• Select tools, equipment and materials.<br>• Construct the machine base<br>• Install generators.<br>• Test generators vibration and | Generators is installed as per installation guideline | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install Generators<br><br>**Principles:** The students should explain the principles of:<br>• Operation of generators. | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs.<br>• A set of screw drivers.<br>• A set of spanners.<br>• Ball pein hammer.<br>• Cross pein hammer.<br>• Megger.<br>• Combination plier.<br>• Diagonal cutting plier. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | Guide students to visualize generator installation<br><br>**Visits**<br>Let students visit school standby generator to study installation procedure | alignment.<br>• observe safety precautions<br>• Clean the work area.<br>• Collect tools, equipment and other items for storage. | | • Testing of generators<br>**Theories:** The students should explain:<br>• Magnetism and characteristic of magnet.<br>• Law of magnetism.<br>• Electro magnetism.<br>• Construction of generators<br>• Application of generators | • Electrician knife.<br>• Safety goggles.<br>• Overall.<br>• Safety boots.<br>• Installation tester.<br>• multimeter.<br>• Clamp on meter.<br>• Gloves. | |
| | 1.2 Installing control of single-phase AC motors | (a) Installing a capacitor start induction motor | **Discussion**<br>Guide students to discuss construction, operation, and applications of capacitor start induction motors.<br>**Demonstration**<br>Show students to<br>• Show the physical components of the motor and explain their functions<br>• mount, wire, and test the | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools, equipment and materials<br>• Install capacitor start induction motor<br>• Terminate cables.<br>• Test capacitor start induction motor<br>• Observe safety precautions<br>• Clean the work | Capacitor start induction motor is installed as per standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to Install capacitor start induction motor.<br>**Principles:** The students should explain the principles of operation of single-phase motor.<br>**Theories:** The students should explain:<br>• Types of single-phase motor | The following tools, safety gear and equipment are to be available:<br>• Set of screw drivers.<br>• multimeter.<br>• Set of open-ended spanners.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Leather and plastic gloves.<br>• Overalls.<br>• Diagonal cutting plier.<br>• Combination plier. | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | motor<br><br>**Practice**<br>Provide students with motors and equipment to practice installation. | place.<br>• Store tools, equipment and safety gear. | | • Operation of single-phase motor<br>• Ratings of single-phase motor<br>• Necessary information obtains on name plate of the motor<br>• Function of capacitor start in single phase motor.<br>• Application of single-phase motor. | | |
| | | (b) Installing a capacitor start-capacitor run induction motor | **Discussion**<br>Guide students to discuss construction, operation, and applications of capacitor start-capacitor run induction motors.<br>**Demonstration**<br>Show students to<br>• Show the physical components of the motor and explain their functions<br>• mount, wire, | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools, equipment and materials<br>• Install capacitor start-capacitor run induction motor<br>• Terminate cables.<br>• Test capacitor start-capacitor run induction motor.<br>• Observe safety precautions | Capacitor start-capacitor run induction motor is installed as per standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to Install capacitor start-capacitor run induction motor.<br>**Principles:** The students should explain the principles of operation of single-phase motor.<br>**Theories:** The students should explain:<br>• Types of single- | The following tools, safety gear and equipment are to be available:<br>• Set of screw drivers.<br>• Analogue and digital multimeter.<br>• Set of open-ended spanners.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Leather and plastic gloves.<br>• Overalls.<br>• Diagonal cutting plier. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | and test the motor<br>**Practice**<br>Provide students with motors and equipment to practice installation. | • Clean the work place.<br>• Store tools, equipment and safety gear. | | phase motor<br>• Operation of single-phase motor<br>• Ratings of single-phase motor<br>• Necessary information obtains on name plate of the motor<br>• Function of capacitor start in single phase motor.<br>• Function of capacitor run in induction motor<br>• Application of single-phase motor. | • Combination plier. | |
| | 1.3 Installing control of three phase AC motors | (a) Installing DOL by using the jogging method. | **Discussion**<br>Guide the students to discuss electromagnetic contactor<br><br>**Visual Aids**<br>Guide students to visualize DOL with the jogging features | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools, equipment and materials<br>• Install DOL by using jogging method<br>• Terminate cables.<br>• Test DOL by using | DOL by using jogging method is installed as per standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to Install single DOL by using jogging method.<br><br>**Principles:** The students should explain the principles of operating motor by jogging method. | The following tools, safety gear and equipment are to be available:<br>• Set of screw drivers.<br>• Analogue and digital multimeter.<br>• Set of open-ended spanners.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Leather and plastic | 24 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | **Demonstration**<br>Show students how to wire a DOL starter with the jogging feature.<br><br>**Practice**<br>Provide students with tools, components and materials to practice DOL installation | jogging method.<br>• Observe safety precautions<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | | **Theories:** The students should explain:<br>• Operation of electromagnetic contactor<br>• The main parts of contactor.<br>• Operation thermal overload relay.<br>• Importance of electromagnetic contactor. | gloves.<br>• Overalls.<br>• Diagonal cutting plier.<br>• Combination plier. | |
| | | (b) Installing a DOL starter self-holding. | **Visual Aids**<br>Guide students to visualize DOL with self-holding features<br>**Demonstration**<br>Show students how to wire a DOL starter with self-holding feature.<br><br>**Practice**<br>Provide students with tools, components and materials to practice DOL installation | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools equipment and materials<br>• Install the DOL control circuit.<br>• Terminate cables.<br>• Test the DOL control circuit.<br>• Observe safety precautions<br>• Clean the work place.<br>• Store tools, | DOL starter self-holding starter is installed as per standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to Install starter self-holding DOL starter.<br>**Principles:** The students should explain the principles of electromagnetic contactors.<br><br>**Theories:** The students should explain:<br>• Operation of electromagnetic | The following tools, safety gear and equipment are to be available:<br>• Set of screw drivers.<br>• multimeter.<br>• Set of open-ended spanners.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Leather and plastic gloves.<br>• Overalls.<br>• Diagonal cutting plier.<br>• Combination plier. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | | equipment and safety gear. | | contactor<br>• The main parts of contactor.<br>• Operation thermal overload relay.<br>• Importance of electromagnetic contactor. | | |
| | | (c) Installing a DOL starter with remote control | **Visual Aids**<br>Guide students to visualize DOL with remote control features<br><br>**Demonstration**<br>Show students how to wire a DOL starter with remote control feature.<br><br>**Practice**<br>Provide students with tools, components and materials to practice DOL installation | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools equipment and materials<br>• Install the DOL control circuit.<br>• Install remote switching of DOL control circuit<br>• Terminate cables.<br>• Test the DOL with remote control circuit.<br>• Observe safety precautions<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | DOL starter with remote control starter is installed as per standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install DOL starter with remote control starter.<br><br>**Principles:** The students should explain the principles of electromagnetic contactors.<br><br>**Theories:** The students should explain:<br>• Operation of electromagnetic contactor<br>• The main parts of contactor.<br>• Operation thermal overload relay.<br>• Importance of | The following tools, safety gear and equipment are to be available:<br>• Set of screw drivers.<br>• multimeter.<br>• Set of open-ended spanners.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Leather and plastic gloves.<br>• Overalls.<br>• Diagonal cutting plier.<br>• Combination plier. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | | | | electromagnetic contactor. | | |
| | | (d) Installing DOL with forward and reverse motor control starter. | **Visual Aids**<br>Guide students to visualize DOL with forward and reverse motor control starter<br><br>**Demonstration**<br>Show students how to wire a DOL starter with forward and reverse motor control starter.<br><br>**Practice**<br>Provide students with tools, components and materials to practice DOL with forward and reverse motor control starter installation | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools equipment and materials<br>• Install the DOL with forward and reverse motor control starter.<br>• Terminate cables.<br>• Test the with forward and reverse motor control.<br>• Observe safety precautions<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | DOL with forward and reverse motor control starter is installed as per standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to install with forward and reverse motor control starter.<br>**Principles:** The students should explain the principles of electromagnetic contactors.<br><br>**Theories:** The students should explain:<br>• Operation of electromagnetic contactor<br>• The main parts of contactor.<br>• Operation thermal overload relay.<br>• Importance of electromagnetic contactor. | The following tools, safety gear and equipment are to be available:<br>• Set of screw drivers.<br>• multimeter.<br>• Set of open-ended spanners.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Leather and plastic gloves.<br>• Overalls.<br>• Diagonal cutting plier.<br>• Combination plier. | |
| | | (e) Installing manual | **Visual Aids**<br>Guide students to | **The students should be able to explain how** | Manual star delta starter is | **Knowledge evidence: Detailed knowledge** | The following tools, safety gear and | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | star delta starter. | visualize manual star delta starter<br>**Demonstration**<br>Show students how to wire a manual star delta starter.<br><br>**Practice**<br>Provide students with tools, components and materials to practice manual star delta starter | **to:**<br>• Interpret wiring diagram.<br>• Select tools, equipment and materials<br>• Install manual operated star delta starter.<br>• Terminate cables.<br>• Test manual operated star delta starter.<br>• Observe safety precautions<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | installed as per standards. | **of:**<br>**Methods used**: The students should explain how to:<br>• Install manual star delta starter.<br>**Principles:** The students should explain the principles of electromagnetic contactors.<br>**Theories:** The students should explain:<br>• Operation of electromagnetic contactor<br>• The main parts of contactor.<br>• Operation of thermal overload relay.<br>• Importance of electromagnetic contactor. | equipment are to be available:<br>• Set of screw drivers.<br>• Analogue and digital multimeter.<br>• Set of open-ended spanners.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Leather and plastic gloves.<br>• Overalls.<br>• Diagonal cutting plier.<br>• Combination plier. | |
| | | (f) Installing automatic star-delta starter. | **Visual Aids**<br>Guide students to visualize automatic star-delta starter<br>**Demonstration**<br>Show students how to wire a automatic star- | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools, equipment and materials<br>• Install automatic | Automatic star-delta starter is installed as per standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**:<br>The students should explain how to install automatic star-delta starter. | The following tools, safety gear and equipment are to be available:<br>• Set of screw drivers.<br>• multimeter.<br>• Set of open-ended spanners.<br>• Work bench. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | delta starter<br><br>**Practice**<br>Provide students with tools, components and materials to practice automatic star-delta starter | star delta starter.<br>• Terminate cables.<br>• Test automatic star delta starter.<br>• observe safety precautions<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | | **Principles:** The students should explain the principles of automatic star-delta starter.<br><br>**Theories:** The students should explain:<br>• Operation of electromagnetic contactor<br>• The main parts of contactor.<br>• Operation of thermal overload relay.<br>• Importance of electromagnetic contactor. | • Safety boots.<br>• Safety goggles.<br>• Leather and plastic gloves.<br>• Overalls.<br><br>• Diagonal cutting plier.<br>• Combination plier. | |
| | | (g) Installing a rotor resistance starter for slip-ring motor | **Discussion**<br>Guide the students to discuss the<br>• Operation of slip-ring motors and the need for a rotor resistance starter.<br>• Addition of resistance during startup | **The students should be able to explain how to:**<br>• Interpret wiring diagram.<br>• Select tools, equipment and material<br>• Install the rotor resistance starter.<br>• Terminate cables.<br>• Test the rotor resistance starter.<br>• Observe safety | Rotor resistance starter for slip-ring motor is installed as per standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to:<br>• Install rotor resistance starter for slip-ring motor.<br>• Install three phase machine control.<br><br>**Principles:** The | The following tools, safety gear and equipment are to be available:<br>• Set of screw drivers.<br>• Analogue and digital multimeter.<br>• Set of open-ended spanners.<br>• Work bench.<br>• Safety boots.<br>• Safety goggles.<br>• Leather and plastic | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | reduces the starting current and torque.<br><br>**Demonstration**<br>Show students<br>• The components of a slip-ring motor<br>• How to wire a rotor resistance starter with the motor<br>**Practice**<br>Provide students with equipment and tools to practice installation of resistor starter | precautions<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | | students should explain the principles of operating wound rotor induction motor.<br><br>**Theories:** The students should explain:<br>• Concept of slip ring.<br>• Production of magnetic flux in wound rotor induction Motor.<br>• Preventive maintenance of wound rotor induction motor.<br>• The application of wound rotor induction motor. | gloves.<br>• Overalls.<br>• Diagonal cutting plier.<br>• Combination plier. | |
| | 1.4 Installing DC machines | (a) Installing DC generators. | **Discussion**<br>Guide the students to discuss<br>• The basic operation and components of a DC | **The students should be able to explain how to:**<br>• Interpret the drawing diagram<br>• Select tools, equipment and material. | DC generator is installed as per manual instructions. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**:<br>The students should explain how to install DC generators. | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs.<br>• A set of screw drivers.<br>• A set of spanners. | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | generator.<br>• Common uses and the importance of proper installation.<br>Demonstration<br>Show students<br>• Tools and materials required for installation.<br>• Step of installing a DC generator<br>**Practice**<br>Guide the students to practice installing a DC generator | • Prepare bed of the D.C. machine.<br>• Install the DC generator on its bed.<br>• Install prime mover<br>• Terminate cable of the DC generator.<br>• Test DC generator.<br>• Clean the work area.<br>• Collect tools, equipment and other items for storage. | | **Principles:** The students should explain the principles of:<br>• Induced emf.<br>• Prime mover.<br><br>**Theories:** The students should explain:<br>• The three basic types of D.C. generator.<br>• The concept of commutation.<br>• Excitation of DC generator.<br>• Carbon brush and commutator | • Ball pein hammer.<br>• Cross pein hammer.<br>• Megger.<br>• Diagonal cutting plier.<br>• Combination plier.<br>• Electrician knife.<br>• Clamp on meter.<br>• multimeter.<br>• Insulation tester.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (b) Installing D.C. motors. | **Discussion**<br>Guide the students to discuss<br>• The various types of DC motors and their components.<br>• The working principle and applications | **The students should be able to explain how to:**<br>• Interpret the drawing diagram.<br>• select tools, equipment and the required material.<br>• Prepare bed of the D.C. motor.<br>• Install DC motor on its bed. | D.C. motors is installed as per terminated as per installation guideline | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to maintain and install D.C. motor.<br>**Principles:** The students should explain the principles of:<br>• Operating D.C. | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs.<br>• A set of screw drivers.<br>• A set of spanners.<br>• Ball pein hammer.<br>• Cross pein hammer.<br>• Megger.<br>• Diagonal cutting | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | of DC motors.<br>**Demonstration**<br>Show students<br>• The parts of the DC motor.<br>• How to wire a DC motor to a power source, controller, and load.<br>**Practice**<br>Guide the students to practice how to install and wire a DC motor based on a provided diagram | • terminate cable<br>• test of DC motor.<br>• Clean the work area.<br>• Collect tools, equipment and other items for storage. | | motor.<br>• Generating DC power supply.<br>**Theories:** The students should explain:<br>• The three basic types of D.C. motor.<br>• The concept of commutation.<br>• Excitation of DC motor.<br>• Carbon brush and commutator | plier.<br>• Combination plier.<br>• Electrician knife.<br>• Clamp on meter.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | 1.5 Installing control of DC machines | (a) Installing diverter resistor to the armature. | **Discussion**<br>Guide the students to discuss<br>• role of resistors in electrical circuits and how they can limit current flow<br>• Function of diverter | **The students should be able to explain how to:**<br>• Interpret wiring diagrams.<br>• Install diverter resistor to armature circuit.<br>• Terminate cables to D.C. machine control systems.<br>• Test the D.C. machine control. | Diverter is installed in the armature of DC machine as per manufacturer specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to:<br>• Install diverter resistor to the armature system.<br>**Principles:**<br>The students should explain the principles of: Operation of D.C. | The following tools, safety gear and equipment are to be available:<br>• Rawl plug.<br>• A set of screw drivers.<br>• Ball pein hammer.<br>• Cross pein hammer.<br>• Megger.<br>• Diagonal cutting plier. | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | resistors and their purpose in controlling starting current.<br>• how diverter resistors fit into the armature circuit.<br>**Demonstration**<br>Demonstrate the step-by-step to students the process of installing the diverter resistors on the motor<br>**Practice**<br>Provide tools and equipment for students to practice installation of diverter | • Observe safety precautions.<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | | machines.<br>**Theories:** The students should explain:<br>• The major parts of D.C. machine control.<br>• The power rating of D.C. machine control.<br>• The application of D.C. machine control. | • Combination plier.<br>• Electrician knife.<br>• Plastic and leather gloves.<br>• multimeter.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (b) Installing VARISTOR in the field winding. | **Discussion**<br>Guide the students to discuss the functions varistor in protecting the motor from overvoltage. | **The students should be able to explain how to:**<br>• Interpret wiring diagrams.<br>• Install VARISTOR in the field winding of DC machine. | D.C. VARISTOR is installed in the field winding of DC machine as per manufacturer ’s | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to:<br>• Install single phase D.C. machine control. | The following tools, safety gear and equipment are to be available:<br>• Rawl plug.<br>• A set of screw drivers.<br>• Ball pein hammer.<br>• Cross pein hammer. | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | **Demonstration**<br>• Show students components of a DC motor, including the field winding and how the varistor is installed across the winding<br>• connection of varistor in parallel with the field winding of the motor<br>• installation of varistor in a DC motor's field winding as per the correct schematic.<br>**Practice**<br>Provide students with tools and equipment to practice installation of Varistor | • terminate cables<br>• Test the D.C. machine control.<br>• Observe safety precautions.<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | specifications . | • Install three phase D.C. machine control.<br>**Principles:** The students should explain the principles of: Operation of D.C. machines.<br>**Theories:** The students should explain:<br>• The types of a D.C. machine control.<br>• The major parts of D.C. machine control.<br>• The application of D.C. machine control. | • Megger.<br>• Diagonal cutting plier.<br>• Combination plier.<br>• Electrician knife.<br>• Plastic and leather gloves.<br>• multimeter.<br>• Insulation tester.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | | (c) Installing | **Description** | **The students should** | Autotransfor | **Knowledge evidence:** | The following tools, | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | Autotransformer starter for DC machine | Guide the students to describe the purpose and working principle of the autotransformer starter<br>**Demonstration**<br>Show students how to<br>• Draw wiring diagram of autotransformer<br>• Install autotransformer starter<br>**Practice**<br>Provide students with tools and equipment to practice installation of autotransformer | **be able to explain how to:**<br>• Interpret wiring diagrams.<br>• Install autotransformer starter<br>• terminate cables<br>• Test the D.C. machine control.<br>• Observe safety precautions.<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | mer starter is for starting D.C. machines installed as per manufacturer's specifications. | **Detailed knowledge of:**<br>**Methods used**: The students should explain how to start DC machine by using autotransformer starter<br><br>**Principles:**<br>The students should be able to explain procedures for Installing autotransformer starter for DC machine<br><br>**Theories:** The students should explain:<br>• Operation of Autotransformer<br>• Concept of rectifier circuit<br>• The importance autotransformer in starting of D.C. machine. | safety gear and equipment are to be available:<br>• Rawl plug.<br>• A set of screw drivers.<br>• Ball pein hammer.<br>• Cross pein hammer.<br>• Megger.<br>• Diagonal cutting plier.<br>• Combination plier.<br>• Electrician knife.<br>• Plastic and leather gloves.<br>• multimeter.<br>• Insulation tester.<br>• Safety goggles.<br>• Safety boots.<br>• Leather and plastic gloves.<br>• Overall. | |
| | 1.6 Installing electronic soft starter | (a) Installing Thyristor control starter. | **Description**<br>Guide the students to describe<br>• basic concept | **The students should be able to explain how to:**<br>• Interpret control wiring diagram. | Thyristor control starter is installed as per manufacturer | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs. | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | of thyristor control<br>• role of each component in the Thyristor Control Starter<br>**Demonstration**<br>Show students<br>• the physical components starter<br>• How to connect and wire each component of the Thyristor Control Starter.<br>**Practice**<br>Provide tools and equipment to students to practice installation of thyristor control starter | • Identify ratings of thyristor control circuit.<br>• Install thyristor control starter<br>• Terminate cables.<br>• Test the thyristor control starter.<br>• Observe safety precautions.<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | 's manual specifications . | explain how to:<br>• Install the Thyristor control starter.<br>• Control the speed of the motor.<br>• Service the Thyristor control starter.<br>**Principles:**<br>The students should explain the principles of operation of the Thyristor control starter.<br>**Theories:** The students should explain:<br>• Formation of the device<br>• Application of the Thyristor control starter.<br>• The main components of Thyristor control starter. | • A set of screw drivers.<br>• Cross pein hammer.<br>• Diagonal cutting plier.<br>• Combination plier.<br>• Electrician knife.<br>• Digital multimeter.<br>• Clamp on meter.<br>• Overall.<br>• Leather and plastic gloves.<br>• Safety goggles.<br>• Drilling machined. | |
| | | (b) Installing TRIAC control starter | **Description**<br>Guide the students to discuss TRIAC control starter<br><br>**Demonstration** | **The students should be able to explain how to:**<br>• Interpret control wiring diagram.<br>• Identify ratings of TRIAC control | The electronic soft starter fixed, installed and functions as per | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used**: The students should explain how to:<br>• Install the TRIAC | The following tools, safety gear and equipment are to be available:<br>• Rawl plugs.<br>• A set of screw drivers. | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | Show students<br>• TRIAC and its role in the control starter system<br>• How to connect the TRIAC, control circuits, and other components together in a working setup.<br>**Practice**<br>Provide tools and equipment for students to practice installation of TRIAC control starter | starter.<br>• Install TRIAC control starter<br>• Terminate cables.<br>• Test the TRIAC control starter.<br>• observe safety precautions.<br>• Clean the work place.<br>• Store tools, equipment and safety gear. | manufacturer's manual specifications. | control starter.<br>• Control the speed of the motor.<br>• Maintain the TRIAC control starter.<br>**Principles:**<br>The students should explain the principles of operation of the TRIAC control starter<br>**Theories:**<br>The students should explain:<br>• Application of the TRIAC control starter.<br>• The main components of TRIAC control starter. | • Cross pein hammer.<br>• Diagonal cutting plier.<br>• Combination plier.<br>• Electrician knife.<br>• Digital multimeter.<br>• Clamp on meter.<br>• Overall.<br>• Leather and plastic gloves.<br>• Safety goggles.<br>• Drilling machined. | |
| | 1.7 Installing variable frequency drive | (a) Identifying VFD components | **Discussion**<br>Guide students to discuss VFD is and its role in motor control applications.<br>**Visual Aids**<br>Guide the students to visualize diagrams and | The students should be able to explain how to:<br>• Interpret VFD diagrams<br>• Interpret VFD manual<br>• Prepare VFD controller<br>• Identify Rectifier<br>• Identify DC Bus | VFD components are identified as per standard | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**:<br>The students should be able to explain VFD components<br><br>**Principles:** The students should explain the principles | The following tools, safety gear and equipment are to be available:<br>• Wire cutters or wire strippers<br>• VFD<br>• Power supply<br>• Desktop computer<br>• Multimeters | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | animations that illustrate the location and function of each component.<br><br>**Demonstration**<br>Show students how to disassemble a VFD to allow students to see internal components<br>**Practice**<br>Provide students with tools and components to practice disassembly and assembly of VFD | • Identify Inverter<br>• Identify Control unit | | of<br>• Electromagnetism<br>• Industrial drive (AC, DC motors)<br><br>**Theory:** The students should explain**:**<br>• Type of AC motors<br>• Type DC motors<br>• Operation of AC and DC motors | • Soldering gun<br>• screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |
| | | (b) Install VFD for controlling industrial drive | **Demonstration**<br>Show students the<br>• layout, including input terminals, output terminals, and control panel<br>• step by step installation of VFD controller | **The students should be able to explain how to** explain how to:<br>• Select tools, equipment and materials<br>• Interpret wiring diagrams<br>• Interpret VFD installation manual<br>• Install VFD<br>• Test VFD operation | VFD for controlling industrial drive is installed as per standard | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**:<br>The students should explain how to Install VFD components<br>**Principles:**<br>The students should explain the principles of Industrial drive controls<br>**Theory:** The students | The following tools, safety gear and equipment are to be available:<br>• Wire cutters or wire strippers<br>• VFD<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• Soldering gun<br>• screw driver set<br>• Digital probes | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | **practice**<br>provide students with tools and equipment to practice VFD installation | • Observe safety precautions<br>• Clean tools and equipment<br>• Store tools and equipment | | should explain**:**<br>• Type of AC motors<br>• Type DC motors<br>• Operation of AC and DC motors<br>• Industrial drive controls | • Safety boots<br>• Safety goggles<br>• Safety gloves | |
| | | (c) Perform VFD parameters settings | **Description**<br>Guide students to describe parameter settings impact on motor performance<br><br>**Demonstration**<br>Show students parameter setting of VFD controller<br><br>**Practice**<br>Provide VFD controller to students to practice parameter setting | **The students should be able to explain how to:**<br>• Set Frequency<br>• Set Voltage<br>• Set Acceleration time<br>• Set deceleration time<br>• Test speed variation of industrial drive | VFD parameters settings are performed as per requirement | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to Perform VFD parameters settings<br>**Principles:** The students should explain the principles of Variation of power supply quantities<br>**Theory:** The students should explain**:**<br>• Effect of Varying voltage<br>• Effect of Varying frequency<br>• Effect of Varying current | The following tools, safety gear and equipment are to be available:<br>• Wire cutters or wire strippers<br>• VFD<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• Soldering gun<br>• Screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |
| | | (d) Perform VFD preventive maintenance | **Discussion**<br>Guide the students to Discuss how preventive | **The students should be able to explain how to:**<br>• Select tools, equipment and | VFD preventive maintenance is performed as per | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should | The following tools, safety gear and equipment are to be available:<br>• Wire cutters or wire | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | maintenance reduces downtime, improves efficiency, and prevents costly repairs.<br><br>**Demonstration**<br>Show students maintenance tasks on a VFD unit.<br><br>**Practice**<br>Provide tools and equipment to students to practice maintenance VFD under supervision. | materials<br>• check cooling systems for temperature control<br>• Blow VFD for moisture and dust removal<br>• Check electrical termination to avoid loose connection<br>• Observe safety precautions<br>• Clean tools and equipment<br>• Store tools and equipment | required standard | explain how to Perform VFD parameters settings<br>**Principles:** The students should explain the principles of<br>Variation of power supply quantities<br>**Theory:**<br>The students should explain**:**<br>• Effect of Varying voltage<br>• Effect of Varying frequency<br>• Effect of Varying current | strippers<br>• VFD<br>• Blower<br>• Hot air blower<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• Soldering gun<br>• Screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |
| 2.0 Installing electronic control and monitoring systems | 2.1 Installing PLC components | (a) Installing the power supply unit (PSU) for PLC | **Discussion**<br>Guide the students to discuss<br>• The role and importance of a PSU in a PLC system.<br>• Different types of PSUs and their specifications. | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret circuit diagram<br>• Install power supply unit<br>• Connect power supply to PLC components | The power supply unit is installed as per technical specifications , | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should explain how to Install power supply unit<br><br>**Principles:** The students should explain the principles of:<br>• Temperature | The following tools, safety gear and equipment are to be available:<br>• Wire cutters or wire strippers<br>• PLC<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• screw driver set<br>• Digital probes | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | **Demonstration**<br>Show students:<br>• tools and materials required for installation<br>• installation process using a test PLC setup<br>**Practice**<br>Provide tools and materials to students to practice PSU installation | • Test the installed PLC<br>• Observe safety precautions<br>• Clean tools, equipment and work area<br>• Store tools, equipment and safety gear. | | control<br>• Connecting protective devices<br><br>**Theories:** The students should explain<br>• Different types of actuators<br>• Function of emergency stop button | • Safety boots<br>• Safety goggles<br>• Safety gloves | |
| | | (b) Installing I/O unit of PLC | **Description**<br>Guide students to describe<br>• The purpose and types of I/O units.<br>• the wiring conventions and addressing methods<br>**Demonstration**<br>Show students<br>• The installation of an I/O unit in a PLC rack or panel. | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Connect I/O to terminal block<br>• Test the installed PLC<br>• Observe safety precautions<br>• Clean tools, equipment and work are<br>• Store tools, equipment and safety gear. | I/O unit is installed as per technical specifications . | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used:**<br>The students should explain how to:<br>• Connect sensors, switches to PLC<br>• Connect the PLC to controlled plant<br><br>**Principles:** The students should explain the principles of:<br>• Sensors, transducers and | The following tools, safety gear and equipment are to be available:<br>• Electrician's tool kit<br>• Wire cutters or wire strippers<br>• PLC<br>• PLC trainer<br>• Training module<br>• Discrete PLC inputs (pre-wired)<br>• Discrete PLC outputs (pre-wired)<br>• Programming cable<br>• Graphic User Interface | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | • The process of connecting inputs (e.g., sensors) and outputs (e.g., actuators).<br>**Practice**<br>Provide tools and materials to students to practice installation of I/O | | | actuators<br>• Connecting protective devices<br><br>**Theories:** The students should explain<br>• Different types of actuators<br>• Function of emergency stop button<br>• Difference between input and output devices | • Power supply<br>• Desktop computer<br>• Multimeters<br>• Precision screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |
| | | (c) Configuring the CPU for PLC | **Descriptions**<br>Guide the students to describe<br>• The purpose and components of the CPU in a PLC system.<br>• The configuration parameters and their importance.<br><br>**Demonstration**<br>Show students<br>• How to connect a PLC CPU using | **The students should be able to explain how to:**<br>• Interpret circuit diagram<br>• Check the hardware availability<br>• Check connection of individual components<br>• Check PLC protection systems<br>• Configure CPU | CPU for PLC is configured as per technical specifications. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used** the students should explain how to:<br>• Configure CPU<br>• Connect sensors, transducer and actuators to PLC<br>• Connect the PLC to control plant<br>**Principles:** The students should explain the procedures for Configuration of the CPU for PLC | The following tools, safety gear and equipment are to be available:<br>• Electrician's tool kit<br>• Wire cutters or wire strippers<br>• PLC<br>• PLC trainer<br>• Training module<br>• Discrete PLC inputs (pre-wired)<br>• Discrete PLC outputs (pre-wired)<br>• Programming cable<br>• Graphic User | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | configuration software.<br>• The steps to set up communication and configure the CPU.<br>**Practice**<br>Provide tools and equipment to students to practice configuring of CPU | | | **Theories:** The students should explain<br>• Different types of actuators<br>• Function of emergency stop button<br>• Difference between input and output devices | Interface<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• Precision screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |
| | | (d) Connecting the PLC base | **Discussion**<br>Guide the students to discuss<br>• The role and importance of the PLC base in system integration.<br>• types of PLC bases and their applications.<br>**Demonstration**<br>Show students the connection of PLC base, including | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret circuit diagram<br>• Check the hardware availability<br>• Connect the PLC base<br>• Connect components to terminal block<br>• Test the installed PLC | Installation of the PLC is performed as per technical specifications, and IET Regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**:<br>The students should explain how to:<br>• Connect sensors, switches to PLC<br>• Connect the PLC to controlled plant<br>**Principles:**<br>The students should explain the procedures for connecting the PLC base.<br>**Theories:** The students should explain | The following tools, safety gear and equipment are to be available:<br>• Electrician's tool kit<br>• Wire cutters or wire strippers<br>• PLC<br>• PLC trainer<br>• Training module<br>• Discrete PLC<br>• inputs (pre-wired)<br>• Discrete PLC<br>• outputs (pre wired)<br>• Programming cable<br>• Graphic User Interface | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | mounting and aligning modules.<br><br>**Practice**<br>Provide tool and materials to students to practice installing of PLC base | • Observe safety precautions<br>• Clean tools, equipment and work area<br>• Store tools, equipment and safety gear. | | • Different types of actuators<br>• Function of emergency stop button<br>• Difference between input and output devices | • Power supply<br>• Desktop computer<br>• Multimeters<br>• Precision screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |
| | 2.2 Performing PLC programmeming | (a) Installing PLC software | **Description**<br>Guide the students to describe<br>• The role of PLC software in industrial automation.<br>• Different software packages and their use<br>**Demonstration**<br>Show students how to install PLC software on a computer<br><br>**Practice**<br>Guide the students to practice software installation in the computer | **The students should be able to explain how to:**<br>• Download programming software<br>• Prepare PLC trainer with inputs and outputs<br>• Connect trainer to power supply<br>• Connect Graphic User Interface<br>• Upload software to PLC<br>• Observe safety precautions | PLC software is installed as per technical specifications | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used:** The students should explain how to:<br>• Install PLC software<br>• Set up a PLC trainer<br>• Download PLC programming software<br>**Principles:** The students should explain the principles of:<br>• PLC Programming.<br>• HMI programming<br>**Theories:** The students should explain<br>• Combination logic programming | The following equipment, tools, and safety gear should be available: -<br>• Wire cutters or wire strippers<br>• PLC<br>• PLC trainer<br>• Training module<br>• Discrete PLC inputs (pre-wired)<br>• Discrete PLC outputs (pre-wired)<br>• Programming cable<br>• Graphic User Interface<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | | | | • Sequential logic programming<br>• Connection between PLC and HMI.<br>• Ladder logic | | |
| | | (b) Perform basic sequence programming circuits | **Description**<br>Guide the students to describe<br>• the concept and importance of sequence programming<br>• The steps involved in designing a sequence programme.<br>**Demonstration**<br>Show students<br>• Create a simple sequence programme.<br>• Rung of the ladder diagram<br><br>**Practice**<br>Guide the students to practice | **The students should be able to explain how to:**<br>• Interpret circuit diagram<br>• Download programming software<br>• Carry out sequence programming<br>• Upload software to PLC<br>• Observe safety precautions | Programming of the PLC performed as per technical specifications and IET Regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used:** The students should explain how to:<br>• Perform sequence programming circuit<br>• Download PLC programming software<br>**Principles:** The students should explain the principles of:<br>• PLC sequence programming.<br>• HMI programming<br>**Theories:** The students should explain<br>• Combination logic programming<br>• Sequential logic programming<br>• Connection between PLC and | The following equipment, tools, and safety gear should be available: -<br>• Wire cutters or wire strippers<br>• PLC<br>• PLC trainer<br>• Training module<br>• Discrete PLC inputs (pre-wired)<br>• Discrete PLC outputs (pre-wired)<br>• Programming cable<br>• Graphic User Interface<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | programming | | | HMI.<br>• Ladder logic | | |
| | | (c) Performing PLC Ladder Logic Programmes | **Description**<br>Guide the students to describe<br>• The concept and importance of ladder logic in industrial automation.<br>• Symbols and terminology used in ladder diagrams.<br><br>**Demonstration**<br>Show students how to creating a ladder logic programme using software.<br><br>**Practice**<br>Guide the students to practice creating Ladder logic | **The students should be able to explain how to:**<br><br>• Interpret circuit diagram<br>• Download programming software<br>• Carry out PLC Ladder Logic programming<br>• Upload software to PLC<br>• Observe safety precautions | PLC Ladder Logic Programme is performed as per technical specifications and Regulations. | **Knowledge evidence: Detailed knowledge of:**<br><br>**Methods used:** The students should explain how to:<br>• Perform PLC Ladder Logic Programming<br>• Set up a PLC trainer<br>• Download PLC programming software<br>**Principles:** The students should explain the principles of:<br>• PLC Programming.<br>• HMI programming<br>**Theories:** The students should explain<br>● Combination logic programming<br>● Sequential logic programming<br>● Connection between PLC and HMI. | The following equipment, tools, and safety equipment should be available: -<br>• Wire cutters or wire strippers<br>• PLC<br>• PLC trainer<br>• Training module<br>• Discrete PLC inputs (pre-wired)<br>• Discrete PLC outputs (pre-wired)<br>• Programming cable<br>• Graphic User Interface<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | | | | • Ladder logic | | |
| | | (d) Connecting input and output devices to PLC | **Description**<br>Guide the students to describe<br>• The types and roles of input/output devices.<br>• The layout of PLC terminals and wiring best practices.<br>**Demonstration**<br>Show students how to connect common input (e.g., a pushbutton) and output (e.g., an indicator light) devices to a PLC.<br><br>**Practice**<br>Guide the students to practice connection of input and output device to PLC | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret circuit diagram<br>• Prepare input and output device<br>• Connect input and output device to PLC<br>• Observe safety precautions<br>• Clean tools, equipment and work area<br>• Store tools, equipment and safety gear. | An input and output device is connected to PLC as per technical specifications and Regulations. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Methods used:** The students should explain how to:<br>• Set up a PLC trainer<br>• Connect input and output devices to PLC<br>• Download PLC programming software<br>**Principles:** The students should explain the principles of:<br>• PLC Programming.<br>• HMI programming<br>**Theories:** The students should explain<br>• Combination logic programming<br>• Sequential logic programming<br>• Connection between PLC and HMI.<br>• Ladder logic | The following equipment, tools, and safety equipment should be available: -<br>• Wire cutters or wire strippers<br>• PLC<br>• PLC trainer<br>• Training module<br>• Discrete PLC inputs (pre-wired)<br>• Discrete PLC outputs (pre-wired)<br>• Programming cable<br>• Graphic User Interface<br>• Power supply<br>• Desktop computer<br>• Multimeters<br>• screw driver set<br>• Digital probes<br>• Safety boots<br>• Safety goggles<br>• Safety gloves | |
| | | (e) Performing | **Description** | **The students should** | Simulation | **Knowledge evidence:** | The following | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | simulation and factory automation | Guide the students to describe<br>• The concept of factory automation, simulation, and its components.<br>• The advantages and applications of simulation in optimizing factory processes.<br>**Demonstration**<br>Show students how to<br>• set up a simple factory automation process (e.g., conveyor system) using simulation software.<br>• Integrate sensors and actuators.<br>**Practice**<br>Guide students to practice sensor | **be able to explain how to:**<br>• Download programming software<br>• Upload software to PLC<br>• Perform simulation of programme | and factory automation is performed as per technical specifications and Regulations. | **Detailed knowledge of:**<br>**Methods used:**<br>The students should explain how to perform simulation of PLC programme<br>**Principles:**<br>The students should explain the principles of:<br>• Writing PLC programme<br>• Simulation of PLC Programme<br>• Factory automation<br>**Theories:** The students should explain<br>• Factory automation<br>• Programme simulation<br>• Industrial process control | equipment, tools, and safety equipment should be available: -<br>• PLC<br>• PLC trainer<br>• Training module<br>• Discrete PLC inputs (pre-wired)<br>• Discrete PLC outputs (pre-wired)<br>• Programming cable<br>• Graphic User Interface<br>• Power supply<br>• Desktop computer | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | and actuators integration | | | | | |
| | 2.3 Installing PLC networking and communication system | (a) Installing PLC communication module | **Discussion**<br>Guide the students to discuss<br>• The various communication modules available for PLCs.<br>• The importance of network configurations and protocols in communication systems.<br>**Demonstration**<br>Show students how to install a communication module onto a PLC and connect it to other devices.<br><br>**Practice**<br>Provide students with tools and equipment to practice installation of communication | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret installation manuals<br>• Interpret circuit diagrams<br>• Interpret ladder programmes<br>• Observe safety precautions<br>• Install PLC communication module<br>• Clean tools, equipment and the work place<br>• Select tools, equipment and safety gear | PLC communication module is installed as per technical specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used:** The students should explain how to perform installation of a PLC system.<br>**Principles:** The students should explain principles involved in:<br>• Operating PLC system<br>• Protecting PLC system<br>• Electric colour coding<br>• Documenting installation process<br>**Theories:** The students should explain: -<br>• Types of PLC systems<br>• Master slave configurations<br>• Ladder programming<br>• Uploading and downloading ladder | The following tools, safety gear and equipment are to be available:<br>-<br>• PLC Installation manuals<br>• Personal computer<br>• PLC programming software<br>• Interface cables<br>• multimeter<br>• screw driver sets<br>• Wire strippers<br>• Pressurized Contact cleaners<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Tool box<br>• Soldering gun<br>• Hot air gun<br>• Air blower<br>• Overall/Overcoat<br>• Safety Boots | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | module | | | • programmes<br>• PLC Operations monitoring process | | |
| | | (b) Install an integrated Human Machine Interface (HIM) line for PLC | **Discussion**<br>Guide the students to discuss<br>• The role of HMI in factory automation and its integration with PLCs.<br>• Communication protocols (e.g., Ethernet/IP, Modbus, Profibus) used for connecting the PLC and HMI.<br>**Demonstration**<br>Show students how to<br>• Install the HMI hardware and connect it to the PLC.<br>• Configure communicatio | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• interpret installation manuals<br>• Interpret circuit diagrams<br>• Interpret ladder programmes<br>• Observe safety precautions<br>• Install an integrated Human Machine Interface (HIM) line for PLC<br>• Perform functional tests<br>• Clean tools, equipment and the work place<br>• Select tools, equipment and safety gear | Integrated Human Machine Interface (HIM) line for PLC is installed as per technical specifications . | **Knowledge evidence: Detailed knowledge of:**<br>**Method used**: The students should explain how to perform installation of Integrated Human Machine Interface (HIM) line for PLC.<br><br>**Principles:** The students should explain principles involved in: Documenting installation process<br><br>**Theories:** The students should explain: -<br>• Integrated Human Machine Interface (HIM) line | The following equipment, tools, and safety equipment should be available: -<br>• PLC Installation manuals<br>• Personal computer<br>• PLC programming software<br>• Interface cables<br>• Ladder programmes in soft and hard copies<br>• Circuit diagrams<br>• Digital multimeter<br>• Precision screw driver sets<br>• Wire strippers<br>• Pressurized Contact cleaners<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Tool box<br>• Soldering gun<br>• Desoldering pumps<br>• Hot air gun<br>• Air blower | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | n between the HMI and PLC.<br><br>**Practice**<br>Guide the students to practice integrated Human Machine Interface (HIM) line for PLC | | | | • Overall/Overcoat<br>• Safety Boots | |
| | | (c) Connect PLC to Supervisory Control and Data Acquisition (SCADA) | **Description**<br>Guide the students to describe<br>• The basics of SCADA systems, PLCs, and the importance of data exchange.<br>• Different communication protocols (Modbus, OPC, Ethernet/IP) and their role in PLC-SCADA communication.<br>**Demonstration** | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• interpret installation manuals<br>• Interpret circuit diagrams<br>• Interpret ladder programmes<br>• Install PLC<br>• Install Supervisory Control and Data Acquisition (SCADA)<br>• Connect PLC to Supervisory Control and Data Acquisition (SCADA) | PLC is connected to Supervisory Control And Data Acquisition (SCADA) as per standard | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Method used:**<br>The students should explain how to install PLC and SCADA.<br>**Principles:** The students should explain principles involved in:<br>• Operating PLC system<br>• Operating SCADA<br>• Adjusting sensors and actuators<br>• Documenting installation process<br>**Theories:** The students should explain: -<br>• Types of PLC systems | The following equipment, tools, and safety equipment should be available: -<br>• PLC Installation manuals<br>• Personal computer<br>• PLC programming software<br>• Interface cables<br>• Circuit diagrams<br>• Multimeter<br>• screw driver sets<br>• Wire strippers<br>• Pressurized Contact cleaners<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Soldering gun<br>• Desoldering pumps | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | Show students how to<br>• Connect the PLC to the SCADA system using communication cables (Ethernet, serial, etc.).<br>• Setup communication parameters and configuration of SCADA software to communicate with the PLC.<br>**Practice**<br>Guide the students to practice connection of PLC to Supervisory Control and Data Acquisition (SCADA) | • Observe safety precautions<br>• Functionally Test PLC Unit<br>• Perform functional tests<br>• Document the installation<br>• Clean tools, equipment and the work place<br>• Select tools, equipment and safety gear | | • Master slave configurations<br>• Ladder programming<br>• Uploading and downloading ladder programmes<br>• PLC Operations monitoring process<br>• PLC firmware updates<br>• Electronic devices<br>• Measurements and instrumentation | • Hot air gun<br>• Air blower<br>• Overall/Overcoat<br>• Safety Boots | |
| 3.0 Installing hybrid systems | 3.1 Installing inverter chargers | (a) Installing single phase inverter charger to | **Description**<br>Guide the students to describe<br>• Importance of | **The students should be able to explain how to:**<br>• Perform power source priority | Single phase inverter charger is installed to system as per | **Knowledge evidence: Detailed knowledge of:**<br>**Method used** the students should | The following tools, safety gear and equipment are to be available: | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | system | a single-phase inverter charger in a power system.<br>• The roles of each component in the system, including safety features like circuit breakers.<br>• Common types of inverter chargers available in the market (e.g., off-grid, hybrid, grid-tied) and their application.<br>**Demonstration**<br>Show students how to<br>• Install a single-phase inverter charger.<br>• Configure settings (e.g., charging rate, load management) | configuration<br>• Configure total charging current for solar and utility chargers.<br>• Configure inverter mode (single phase/three phase)<br>• Configure charge source priority. | technical specifications | explain how to perform installation of single phase inverter charger.<br>**Principles:** The students should explain principles of Electrical power conversion<br>**Theories:** The students should explain: -<br>• inverter operation mode.<br>• Types of inverter<br>• Inverter stacking.<br>• Applications of inverter. | • First aid<br>• Digital multimeter<br>• screw driver sets<br>• Wire strippers<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Overall/Overcoat<br>• Safety Boots<br>• Hand drilling machine<br>• Single phase inverter charger<br>• Gloves | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | on the inverter charger if necessary.<br>**Practice**<br>Provide students with tools and equipment to practice installation and configuration of in single phase inverter charger | | | | | |
| | | (b) Installing Stacked three phase inverters | **Description**<br>Guide the students to describe<br>• Importance of a three-phase inverter charger in a power system.<br>• The roles of each component in the system, including safety features like circuit breakers.<br>• Common types of three-phase inverter chargers available in | **The students should be able to explain how to:**<br>• Perform power source priority configuration<br>• Configure total charging current for solar and utility chargers.<br>• Install three phase inverter charger<br>• Perform three phase inverters stacking<br>• Configure charge source priority.<br>• Observe safety precautions.<br>• Clean the work place. | Inverter chargers installed according to technical specifications | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to perform installation of Inverter charger.<br><br>**Principles:** The students should explain principles of Electrical power conversion and Ohm's law:<br><br>**Theories:** The students should explain: -<br>• Different inverter operation mode.<br>• Types of inverters | The following tools, safety gear and equipment are to be available:<br><br>• First aid<br>• Digital multimeter<br>• screw driver sets<br>• Wire strippers<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Overall/Overcoat<br>• Safety Boots<br>• Hand drilling machine<br>• Stacked three phase inverter chargers | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | the market (e.g., off-grid, hybrid, grid-tied) and their application.<br>**Demonstration**<br>Show students how to<br>• Install a three-phase inverter charger.<br>• Configure settings (e.g., charging rate, load management) on the inverter charger if necessary.<br>**Practice**<br>Provide students with tools and equipment to practice installation and configuration of in three phase inverter charger | • Store tools, equipment and safety equipment. | | • Inverter stacking.<br>• Applications of inverter. | | |
| | 3.2 Installing change over switch | (a) Installing manual changeover switch | **Description**<br>Guide the students to describe<br>• The concept of manual | **The students should be able to explain how to:**<br>• Interpret wiring diagrams<br>• Size changeover | A manual change-over switch is installed as per regulations | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to | The following tools, safety gear and equipment are to be available:<br>• First aid<br>• Digital Multimeter | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | changeover switches, their purpose, and applications in various settings (e.g., residential, industrial).<br>• the operation of the switch, including how to safely operate it when switching between power sources.<br>**Demonstration**<br>Show students how to install a manual changeover switch,<br>**Practice**<br>Provide tools and equipment to students to practice installation of changeover switch | switch as per system requirements<br>• Select tools equipment and materials required<br>• Install manual changeover switch<br>• Observe safety precautions.<br>• Clean the workplace.<br>• Store tools, equipment and safety equipment. | and standards. | perform the installation manual changeover switch.<br><br>**Principles:** The students should explain the principles of the transfer switch. principles of transfer switch<br><br>**Theories:** The students should explain: -<br>• Different changeover operation modes.<br>• Types of change over switch.<br>• Principles of electromagnetic switches. | • screwdriver sets<br>• Wire strippers<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Overall/Overcoat<br>• Safety Boots<br>• Hand drilling machine | |
| | | (b) Installing automatic | **Description**<br>Guide the | **The students should be able to explain how** | Automatic Change over | **Knowledge evidence: Detailed knowledge** | The following tools, safety gear and | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | changeover switch | students to describe<br>• The concept of automatic changeover switches, their purpose, and applications in various settings (e.g., residential, industrial).<br>• The operation of the switch, including how to safely operate it when switching between power sources.<br>**Demonstration**<br>Show students how to install a automatic changeover switch,<br>**Practice**<br>Provide tools and equipment to students to practice installation of the | **to:**<br>• Interpret wiring diagrams<br>• Select tools, equipment and materials required<br>• Install automatic changeover switch<br>• Observe safety precautions.<br>• Clean the work place.<br>• Store tools, equipment and safety equipment. | switch is installed as per regulations and standards. | **of:**<br>**Method used:** The students should explain how to perform installation of automatic changeover switch.<br><br>**Principles:** The students should explain principles of transfer switch.<br><br>**Theories:** The students should explain:<br>• Different changeover operation mode.<br>• Types of change over switch.<br>• Principles of electromagnetic switches. | equipment are to be available:<br>• First aid<br>• Digital multimeter<br>• screw driver sets<br>• Wire strippers<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Overall/Overcoat<br>• Safety Boots<br>• Hand drilling machine | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | changeover switch | | | | | |
| | 3.3 Installing hybrid solar PV system | (a) Iinstalling on grid solar PV system | Description<br>Guide the students to describe<br>• Components of an on-grid solar PV system<br>• Integration of components to generate, convert, and distribute energy.<br>• Sizing of the solar system based on energy needs, available roof space, and available sunlight.<br>**Demonstration**<br>Show students how to install an on-grid solar system, from mounting the solar panels to connecting the inverter and grid.<br>**Practice** | **The students should be able to explain how to:**<br>• Interpret wiring diagrams<br>• Select tools, equipment and materials<br>• Install solar PV panels as per requirement<br>• Install grid tie inverters<br>• Connect system to grid<br>• Observe safety precautions.<br>• Clean the work place.<br>• Store tools, equipment and safety equipment. | on grid solar PV system is installed as per requirement and standards | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Install on grid Solar PV system<br>• Maintain on grid solar PV system.<br>**Principles:** The students should explain principles of photovoltaic cells, energy storage material and grid tie inverters.<br><br>**Theories:** The students should explain:<br>• Types of interactive inverter and their application | The following tools, safety gear and equipment are to be available:<br>• First aid<br>• Digital multimeter<br>• screw driver sets<br>• Wire strippers<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Overall/Overcoat<br>• Safety Boots<br>• Hand drilling machine | 16 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | Provide students with tools and equipment to practice installation of on grid inverter | | | | | |
| | | (b) Installing off grid connected solar PV systems | Description<br>Guide the students to describe<br>• The components of the off-grid solar system,<br>• size a system for different applications based on energy<br>**demonstration**<br>Show students how to install the solar panels, wire the system, and install the charge controller and inverter | **The students should be able to explain how to:**<br>• Interpret wiring diagrams<br>• Install Automatic hybrid power controller<br>• Install hybrid inverters<br>• Install batteries<br>• Observe safety precautions.<br>• Clean the work place.<br>• Store tools, equipment and safety equipment... | Hybrid solar PV system installed as per recommended rules and regulations to meet specified standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Install hybrid Solar PV system<br>• Maintain hybrid solar systems.<br><br>**Principles:** The students should explain principles of photovoltaic cells and energy storage material.<br><br>**Theories:** The students should explain:<br>• Types of interactive inverter and their application.<br>• Electrical controllers and their functions | The following tools, safety gear and equipment are to be available:<br>• First aid<br>• Digital multimeter<br>• screw driver sets<br>• Wire strippers<br>• Crimping tools<br>• Magnifying glasses<br>• Safety goggles<br>• Overall/Overcoat<br>• Safety Boots<br>• Hand drilling machine | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| 4.0 Fabricating solar thermal systems | 4.1 Developing solar heater | (a) Making Flat plate collector solar water heater | **Discussion**<br>Guide students to discuss the factors that influence the design of the system, such as water demand, panel size, location, and orientation<br>**Demonstration**<br>Show students how to assemble the flat plate collector, from constructing the frame and absorber plate to the installation of pipes and glazing.<br><br>**Practice**<br>Provide students with tools and equipment to practice to assemble Flat plate collector solar water heater | **The students should be able to explain how to:**<br>• Make black-body surface<br>• Assemble copper tubing under black-body surface<br>• Cover black-body surface with transparent<br>• Perform plumbing works<br>Test the Flat plate collector solar water heater<br>• Clean tools and equipment<br>• Store tools and equipment | Flat plate collector solar water heater is made as per requirement | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Interpret drawings<br>• Fabricate Flat plate collector solar water heater<br>• Perform piping (inlet/outlet)<br>• Install storage tank and its accessories.<br>**Principles:** The students should explain principles of:<br>• Thermodynamics<br>• Fluid dynamics<br>**Theories:** The students should explain: Flat plate collector solar water heater | The following tools, safety gear and equipment are to be available:<br>• Set of drill and drill bits.<br>• Forster drill bit<br>• Screw driver set<br>• Right angle clamps<br>• Handsaw<br>• Metal sheet scissors<br>• Copper tubing cutter<br>• Paint brushes<br>• Burner and soldering equipment.<br>• Silicon gun<br>• Polypropylene Random co polymer (PP-R) pipe welding equipment<br>• Copper pipe bending tools<br>• PPR-pipe scissors<br>• Set of hammers<br>• Measuring tape<br>• Set of wrenches.<br>• Set of PPEs | 16 |
| | | (b) Making evacuated tube collector solar water | **Discussion**<br>Guide students to discuss the factors that influence the design of | **The students should be able to explain how to:**<br>• Make black-body surface | Evacuated tube collector solar water heater is constructed | **Knowledge evidence: Detailed knowledge of:**<br>**Methods used**: The students should | The following tools, safety gear and equipment are to be available:<br>• Set of drill and drill | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | heater | evacuated tube collector solar water heater, such as water demand, panel size, location, and orientation<br>**Demonstration**<br>Show students how to assemble the evacuated tube collector solar water heater from constructing the frame and absorber plate to the installation of pipes and glazing.<br><br>**Practice**<br>Provide students with tools and equipment to practice to assemble evacuated tube collector solar water heater | • Make copper tubing under blackbody surface<br>• Cover evacuated tube collector solar water heater with transparent glass.<br>• Perform plumbing works<br>• Test the<br>• Clean tools and equipment<br>• Store tools and equipment | as per required standards and procedures. | explain how to:<br>• Interpret the drawings<br>• Assemble evacuated tube collector solar water heater.<br>• **Principles:** The students should explain principles of:<br>• evacuated tube collector solar water heater | bits.<br>• Forster drill bit<br>• Screw driver set<br>• Right angle clamps<br>• Handsaw<br>• Metal sheet scissors<br>• Copper tubing cutter<br>• Paint brushes<br>• Burner and soldering equipment.<br>• Silicon gun<br>• Polypropylene Random co polymer (PP-R) pipe welding equipment<br>• Copper pipe bending tools<br>• PPR-pipe scissors<br>• Set of hammers<br>• Multimeter<br>• Measuring tape<br>• Set of wrenches.<br>• Set of PPEs | |
| | | (c) Making heat pump system solar water heater | **Discussion**<br>Guide students to discuss the factors that influence the design of heat pump system | **The students should be able to explain how to:**<br>• Make black-body surface<br>• Assemble heat | Make copper tubing under black body surface is constructed required | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to: | The following tools, safety gear and equipment are to be available:<br>• Set of drill and drill bits. | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | solar water heater, such as water demand, panel size, location, and orientation<br>**Demonstration**<br>Show students how to assemble the heat pump system solar water heater from constructing the frame and absorber plate to the installation of pipes and glazing.<br><br>**Practice**<br>Provide students with tools and equipment to practice to assemble heat pump system solar water heater | pump system solar water heater<br>• Make copper tubing under blackbody surface<br>• Cover transparent glass on black-body surface.<br>• Perform plumbing works<br>• Test Make copper tubing under black body surface<br>• Clean tools and equipment<br>• Store tools and equipment | standards and procedures. | • Interpret drawings<br>• Assemble copper tubing under blackbody surface<br>**Principles:** The students should explain principles of heat pump system solar water heater<br><br>**Theories:** the students should be able to explain<br>• Importance of heat pump<br>• Procedure of making heat pump<br>• Application of heat pump | • Forster drill bit<br>• Screw driver set<br>• Right angle clamps<br>• Handsaw<br>• Metal sheet scissors<br>• Copper tubing cutter<br>• Paint brushes<br>• Burner and soldering equipment.<br>• Silicon gun<br>• Polypropylene Random co polymer (PP-R) pipe welding equipment<br>• Copper pipe bending tools<br>• PPR-pipe scissors<br>• Set of hammers<br>• Multimeter<br>• Measuring tape<br>• Set of wrenches.<br>• Set of PPEs | |
| | 4.2 Developing solar paraboloic concentrator | (a) Making stationary concentrating collectors | **Discussion**<br>Guide students to discuss the factors that influence the design of stationary concentrating collectors, such as water demand, | **The students should be able to explain how to:**<br>• Choose proper materials.<br>• Perform curving<br>• Make cooking supporting structure. | stationary concentrating collectors is made as per requirements | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Identify drawings<br>• Fabricate stationary | The following tools, safety gear and equipment are to be available:<br>• Set of drill and drill bits.<br>• Forster drill bit.<br>• Screw driver set<br>• Set of clamps | 16 |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | panel size, location, and orientation<br>**Demonstration**<br>Show students how to assemble stationary concentrating collectors from constructing the frame and absorber plate to the installation of pipes and glazing.<br><br>**Practice**<br>Provide students with tools and equipment to practice to assemble stationary concentrating collectors | • Make parabolic base structure<br>• Perform welding<br>• Assemble reflectors to shape focal point | | concentrating collectors<br>**Principles:** The students should explain principles of :<br>• Light reflection<br>• Light absorption.<br><br>**Theories:** The students should explain: stationary concentrating collectors | • Handsaw<br>• Paint brushes<br>• Burner and soldering equipment.<br>• Set of hammers<br>• Multimeter<br>• Measuring tape<br>• Ambient weather pyranometer<br>• HDE Infrared thermometer<br>• Set of wrenches.<br>• Set of PPEs | |
| | | (b) Making sun tracking concentrating collectors | **Discussion**<br>Guide students to discuss the factors that influence the design of sun tracking concentrating collectors, such as water demand, panel size, | **The students should be able to explain how to:**<br>• Choose proper material.<br>• Perform curving a<br>• Make cooking supporting structure.<br>• Fabricate the parts | Sun tracking concentrating collectors is made as per required standards and procedures. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Interpret drawings<br>• Fabricate parts of sun tracking concentrating | The following tools, safety gear and equipment are to be available:<br>• Set of drill and drill bits.<br>• Forster drill bit.<br>• Screw driver set<br>• Set of clamps<br>• Handsaw | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | location, and orientation<br>**Demonstration**<br>Show students how to assemble sun tracking concentrating collectors from constructing the frame and absorber plate to the installation of pipes and glazing.<br><br>**Practice**<br>Provide students with tools and equipment to practice to assemble sun tracking concentrating collectors | of sun tracking concentrating collectors<br>• Perform welding<br>• Assemble sun tracking concentrating collectors<br>• Observe safety rules<br>• Store tools, equipment and materials<br>• Clean working area | | collectors<br>• Assemble sun tracking concentrating collectors.<br>**Principles:** The students should explain principles of :<br>• Light reflection<br>• Light absorption.<br>**Theories:** The students should explain:<br>• Operation of sun tracking concentrating<br>• Materials used to make sun tracking concentrating<br>• Application of sun tracking concentrating | • Paint brushes<br>• Burner and soldering equipment.<br>• Set of hammers<br>• Multimeter<br>• Measuring tape<br>• Ambient weather pyranometer<br>• HDE Infrared thermometer<br>• Set of wrenches.<br>• Set of PPEs | |
| | 4.3 Developing solar dryers | (a) Making integrated solar dryer | **Discussion**<br>Guide students to discuss concept of solar drying, how it works, and why it's a sustainable choice for drying various products.<br><br>**Demonstration**<br>Show students | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret circuit diagrams<br>• Design integrated solar drier<br>• Fabricate intergrate | Solar dryer works as per technical specifications . | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Construct integrated solar drier<br>• Determine size of integrated solar | The following tools, safety gear and equipment are to be available:<br>• Set of drill and drill bits.<br>• Forster drill bit.<br>• Screw driver set<br>• Set of clamps<br>• Handsaw<br>• Paint brushes | 16 |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | how to install the dryer system and test it for functionality, ensuring proper air circulation and heat distribution.<br><br>**Practice**<br>Provide students with tools and equipment to practice to assembling integrated solar dryer | solar drier<br>• Test efficiency of integrated solar drier<br>• Observe safety precautions<br>• Clean tools, equipment and work area<br>• Store tools, equipment and safety gear. | | drier<br>**Principles:** The students should explain the principles of:<br>• Constructing integrated solar drier<br>• Sizing integrated solar drier<br>**Theories:** The students should explain<br>• Functioning of integrated solar drier<br>• Basic parts of integrated solar drier<br>• Application of integrated drier | • Burner and soldering equipment.<br>• Set of hammers<br>• Multimeter<br>• Measuring tape<br>• Ambient weather pyranometer<br>• HDE Infrared thermometer<br>• Set of wrenches.<br>• Set of PPEs | |
| | | (b) Making distributed solar dryer | **Discussion**<br>Guide students to discuss concept distributed network works, the concept of shared resources, and the potential for collective community impact.<br><br>**Demonstration** | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret distributed solar dryer drawings<br>• Fabricate distributed solar dryer<br>• Test the efficiency of distributed solar dryer | Distributed solar dryer is made as per technical specifications. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Construct distributed solar dryer<br>• Determine size of distributed solar dryer<br>**Principles:** The | The following tools, safety gear and equipment are to be available:<br>• Set of drill and drill bits.<br>• Forster drill bit.<br>• Screw driver set<br>• Set of clamps<br>• Handsaw<br>• Paint brushes<br>• Burner and soldering | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | Show students how to construct distributed solar dryer.<br><br>**Practice**<br>Provide students with tools and equipment to practice to assembling integrated solar dryer | • Observe safety precautions<br>• Clean tools, equipment and work area<br>• Store tools, equipment and safety gear. | | students should explain the principles of:<br>• Distributed solar dryer.<br>• Sizing distributed solar dryer<br>**Theories:** The students should explain<br>• Functioning of distributed solar dryer<br>• Basic parts of distributed solar<br>• Application of distributed drier | equipment.<br>• Set of hammers<br>• Multimeter<br>• Measuring tape<br>• Ambient weather pyranometer<br>• HDE Infrared thermometer<br>• Set of wrenches.<br>• Set of PPEs | |
| | | (c) Making mixed mode solar dryer | **Discussion**<br>Guide students to discuss concept distributed network works, the concept of shared resources, and the potential for collective community impact.<br><br>**Demonstration**<br>Show students how to construct distributed solar dryer. | **The students should be able to explain how to:**<br>• Select tools, equipment and safety gear<br>• Interpret mixed mode solar dryer drawings<br>• Fabricate mixed mode solar dryer<br>• Test the efficiency mixed mode solar dryer<br>• Observe safety precautions | Mixed mode solar dryer is made as per technical specifications . | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Construct mixed mode solar dryer<br>• Determine size of mixed mode solar dryer<br>**Principles:** The students should explain the principles of:<br>• Working of mixed mode solar dryer. | The following tools, safety gear and equipment are to be available:<br>• Set of drill and drill bits.<br>• Forster drill bit.<br>• Screw driver set<br>• Set of clamps<br>• Handsaw<br>• Paint brushes<br>• Burner and soldering equipment.<br>• Set of hammers<br>• Multimeter<br>• Measuring tape | |

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| | | | **Practice**<br>Provide students with tools and equipment to practice to assembling integrated solar dryer | • Clean tools, equipment and work area<br>• Store tools, equipment and safety gear. | | • Sizing mixed mode solar dryer<br>**Theories:** The students should explain<br>• Functioning of mixed mode solar dryer<br>• Basic parts of solar dries<br>• Application of mixed mode solar drier | • Ambient weather pyranometer<br>• HDE Infrared thermometer<br>• Set of wrenches.<br>• Set of PPEs | |
| 5.0 Maintaining and managing solar PV systems | 5.1 Performing routine maintenance | (a) Performing battery maintenance | **Discussion**<br>Guide the students to discuss problems like sulfation, overcharging, and thermal runaway.<br>**Demonstration**<br>Show students how to<br>• Inspect battery terminals, casing, and electrolyte levels.<br>• Clean terminals and removing corrosion. | **The students should be able to explain how to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Prepare routine maintenance programmes<br>• Check relative density of acid (flooded Batteries)<br>• Check batteries terminals tightness<br>• Clean batteris<br>• Check batteries state of charge<br>• Check batteries state of health | Battery maintenance is performed as per required standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Prepare inspection report<br>• Perform routine maintenance training<br>**Principles:** The students should how to perform battery maintenance<br><br>**Theories:** The students should explain:<br>• Maintenance | equipment, tools, and safety equipment should be available:<br>• General hand foot kit<br>• Workshop tools, equipment and machines<br>• Service manuals<br>• Gloves<br>• Overall<br>• Safety boots<br>• Safety clear<br>• Safety lasses<br>• Helmet<br>• Mask<br>• Ear plug<br>• Electrician ladder | 8 |

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| | | | • Use a multimeter or battery tester to measure voltage and assess battery health.<br>**Practice**<br>Provide tools and measuring instruments to maintain the batteries | • Clean tools and equipment<br>• Store tools and equipment | | schedule reports<br>• Common faults in batteries<br>• Preparing routine maintenance schedule | | |
| | | (b) Performing PV cleanness | Guide students to discuss how to inspect a PV panel for dirt and debris<br><br>**Demonstration**<br>Show students how to<br>• Clean a PV panel<br>• Cut trees to remove shades<br>**Practice**<br>Provide tools and solar panel to practice solar PV cleaning | **The students should be able to explain how to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Prepare routine maintenance programmes<br>• Clean the solar cell modules<br>• Check cables<br>• Clean tools and equipment<br>• Store tools and equipment | Routine maintenance performed as per required workshop standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Prepare inspection report<br>• perform routine maintenance training<br>**Principles:** The students should explain principles of:<br>• Preparing routine maintenance schedule<br>• Perform | The following tools, safety gear and equipment are to be available:<br>• General hand foot kit<br>• Workshop tools, equipment and machines<br>• Service manuals<br>• Gloves<br>• Overall<br>• Safety boots<br>• Safety clear<br>• Safety lasses<br>• Helmet<br>• Mask<br>• Ear plug<br>• Electrician ladder | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | | | | workshop inventory<br>**Theories:** The students should explain:<br>• Importance of interpret service manuals<br>• Importance of preparing inspection and maintenance schedule reports | | |
| | | (c) Inspecting wiring and control mechanisms | Visual Aids<br>Guide the students to visualize videos showing faulty wiring and control systems.<br><br>**Demonstration**<br>Show students how to<br>• Use tools like a multimeter and insulation tester.<br>• Simulate functional testing of control mechanisms. | **The students should be able to explain how to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Make periodic inspection of wiring and control mechanism.<br>• Prepare site inspection report<br>• Prepare routine maintenance programmes<br>• Check solar PV system wiring<br>• Clean tools and equipment | Routine maintenance performed as per required workshop standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Prepare inspection report<br>• perform routine maintenance training<br>**Principles:** The students should explain principles of:<br>• Preparing routine maintenance schedule<br>• Perform workshop | The following tools, safety gear and equipment are to be available:<br>• General hand foot kit<br>• Workshop tools, equipment and machines<br>• Service manuals<br>• Gloves<br>• Overall<br>• Safety boots<br>• Safety clear<br>• Safety lasses<br>• Helmet<br>• Mask<br>• Ear plug<br>• Electrician ladder | |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | **Practice**<br>Provide tools to students to practice functional test of wiring system | • Store tools and equipment | | inventory<br>**Theories:** The students should explain:<br>• Importance of interpret service manuals<br>• Importance of preparing inspection and maintenance schedule reports<br>• Importance of preparing maintenance training programme | | |
| | | (d) Inspecting mounting structure tightness | **Discussion**<br>Guide students to discuss common issues and their impact on safety and performance of mounting structure.<br><br>**Demonstration**<br>Show students how to inspect and tighten bolts using a torque wrench.<br><br>**Practice** | **The students should be able to explain how to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Prepare routine maintenance programmes<br>• Check PV system mounting structure<br>• Perform repainting if necessary<br>• Re-tightening of bolt and nut for | Mounting structure tightness is inspected as per required standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Prepare inspection report<br>• perform routine maintenance training<br>**Principles:** The students should explain principles of:<br>• Preparing routine | The following tools, safety gear and equipment are to be available:<br>• General hand foot kit<br>• Workshop tools, equipment and machines<br>• Service manuals<br>• Gloves<br>• Overall<br>• Safety boots<br>• Safety clear<br>• Safety lasses<br>• Helmet | |

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| | | | Provide tools and equipment to practice maintenance of mounting structure | mounting structure<br>• Clean tools and equipment<br>• Store tools and equipment | | maintenance schedule<br>• Perform workshop inventory<br>**Theories:** The students should explain:<br>• Importance of interpret service manuals<br>• Importance of preparing inspection and maintenance schedule reports<br>• Importance of preparing maintenance training programme | • Mask<br>• Ear plug<br>• Electrician ladder | |
| | 5.2 Performing **system** corrective maintenance | (a) Troubleshooting Solar PV system | **Description**<br>Guide the students to describe troubleshooting flowcharts and tools<br><br>**Demonstration**<br>Show students how to<br>• Measure | **The students should be able to explain how to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Make periodic inspection of Solar PV<br>• Perform corrective maintenance | Solar PV system is troubleshot as per guideline. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Prepare inspection report<br>• Prepare colour codes and safety signed<br>• Plan and perform | The following tools, safety gear and equipment are to be available:<br>• General hand foot kit<br>• Service manuals<br>• Gloves<br>• Overall<br>• Safety boots<br>• Safety clear<br>• Safety lasses | 8 |

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| | | | voltage and current in PV modules.<br>• Detect fault in inverters and controllers.<br>• Simulate common problems like loose connections or dirty panels.<br>**Practice**<br>Provide tools to students to practice troubleshooting on solar PV system | • Troubleshoot the system<br>• Clean tools and equipment<br>• Store tools and equipment. | | corrective routine maintenance training<br>**Principles:** The students should explain principles of:<br>• Preparing colour codes and safety signs<br>**Theories:** The students should explain:<br>• Importance of interpret service manuals<br>• Importance of preparing inspection and maintenance schedule reports | • Helmet<br>• Mask<br>• Ear plug<br>• Electrician ladder | |
| | | (b) Dismantling defective part of solar PV system and replace | Discussion<br>Guide the students to discuss the tools and safety measures for dismantling and replacing parts.<br><br>Demonstration<br>Show students how to<br>• Safely isolate | **The students should be able to explain how to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Dismantle defective part of solar PV system<br>• Replace of worn-out devices | Corrective maintenance performed as per required workshop standards. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Prepare maintenance report<br>**Principles:** The students should explain principles of: maintenance schedule | The following tools, safety gear and equipment are to be available:<br>• General hand foot kit<br>• Service manuals<br>• Gloves<br>• Overall<br>• Safety boots<br>• Safety clear<br>• Safety lasses | |

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| | | | the system and dismantle defective components.<br>• Replace the defective parts.<br>• Test to ensure system functionality.<br>**Practice**<br>Provide students with tools and spare parts to practice replacement of defective parts | • Assemble Solar PV system<br>• Test the entire PV system functionality<br>• Clean tools and equipment<br>• Store tools and equipment. | | • Perform workshop inventory<br>**Theories:** The students should explain Importance of interpret service manuals | • Helmet<br>• Mask<br>• Ear plug<br>• Electrician ladder | |
| 6.0 Managing resources | 6.1 Establishing tools, equipment and materials profile. | (a) Preparing list of tools, equipment and materials. | **Discussion**<br>Guide the students to discuss important tools needed for daily operation<br><br>**Demonstration**<br>Show students how to prepare list of tools, equipment and materials.<br><br>**Practice**<br>Guide the students to | **The students should be able to explain how to:**<br>• Identify tools and equipment as per company profile.<br>• Identify materials needed as per specification. | List of tools, equipment and materials is prepared as per requirement. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Method used:** The students should explain how to establish list of tools and equipment for a given task.<br>**Principles:** The students should explain the principles of making a tools and equipment profile for a given job.<br>**Theories:** The students should | The following tools, safety gear and equipment are to be available:<br>• Skills log-book.<br>• Tools and equipment catalogue.<br>• Computer<br>• Stationery.<br>• Scientific calculator.<br>• Staple machine. | 8 |

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| | | | practice reparation of list of tools, equipment and materials<br><br>**Study tour**<br>Prepare study tour for students to visit nearby industry to learn inventory of tools, equipment and materials | | | explain the importance taking inventory | | |
| | | (b) Creating database using computer | **Visual Aids**<br>Guide students to visualize diagrams, charts, image or video to illustrating database structures and relationships<br><br>**Demonstration**<br>Show students how to create database using computer<br><br>**Practice**<br>Guide the students practice creation of | **The students should be able to explain how to:**<br>• Interpret electrical diagram.<br>• List tools and equipment for a specific job.<br>• Enter task in one column and enter required tools and equipment in next column.<br>• Add a third column to indicate quantity.<br>• List materials for a specific task in a requisition form. | Tools, equipment and materials profile hand-book produced as reference for electricians as per catalogue manual specifications . | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to establish list tools and equipment for a given task.<br><br>**Principles:** The students should explain the principles of making a tools and equipment profile for a given job.<br><br>**Theories:** The students should explain the importance | The following tools, safety gear and equipment are to be available:<br>• Skills log-book.<br>• Tools and equipment catalogue.<br>• Computer<br>• Stationeries.<br>• Scientific calculator.<br>• Staple machine.<br>• Overcoat.<br>• Helmet.<br>• Safety goggles. | |

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| | | | database using computer | • Catalogue the data as a reference tools and equipment profile source book. | | of making a standard reference data book of tools required for various electrical tasks. | | |
| | 6.2 Estimating materials and labour costs | (a) Preparing estimate of materials required to accomplish work | **Description**<br>Guide the students to describe<br>• Aspects, including the purpose and benefits of material estimation.<br>• Common challenges and mistakes in estimating materials.<br>**Case study**<br>Guide students to use real-world examples illustrate concepts.<br>Demonstration<br>Show students how to<br>• Analyse a project plan and extract | **The students should be able to explain how to:**<br>• Interpret the drawing.<br>• Identify required materials.<br>• Prepare technical specification.<br>• Prepare bills of quantities (BOQ). | estimate of materials required to accomplish work is prepared as per standard | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Read the drawing<br>• Identify material needed.<br>• Calculate the cost of materials.<br>**Principles:** the students should be able to explain how to prepare estimate of materials required to accomplish work<br>**Theories:** The students should explain:<br>• The importance of estimating materials cost | The following tools, safety gear and equipment are to be available:<br>• Installation lay out plan.<br>• Stationery.<br>• Scientific calculator.<br>• Staple machine.<br>• Unit prices of the materials. | 8 |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | material requirements<br>• Calculate quantities estimation<br><br>**Practice**<br>Guide the students to practice materials requirements | | | | | |
| | | (b) Carrying out the labour cost for accomplishing work | **Discussion**<br>Guide the students to discuss the aspects of labour cost calculation.<br><br>**Visual Aids**<br>Guide the students to visualize charts, graphs, image or video to showing labour cost distribution.<br><br>**Demonstration**<br>Show students how to calculate labour costs using a real-world example or software like MS | **The students should be able to explain how to:**<br>• Interpret the drawing.<br>• Prepare labour cost including other overheads. | labour cost for accomplishing work is carried out as per standard | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Read the drawing<br>• Calculate the cost of labour .<br><br>**Principles:** The students should explain the principles of man hour rate to cost estimates.<br><br>**Theories:** The students should explain importance of estimating labour cost. | The following tools, safety gear and equipment are to be available:<br>• Installation lay out plan.<br>• Stationery.<br>• Scientific calculator.<br>• Staple machine.<br>• Unit prices of the materials. | |

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| | | | Excel.<br>**Practice**<br>Guide the students to practice labour cost calculations | | | | | |
| | 6.3 Preparing a small-scale tender document | (a) Preparing detailed scope of work (SOW) | Discussion<br>Guide the students to discuss<br>• The purpose and importance of an SOW.<br>• Present examples of well-written and poorly-written SOWs for comparison.<br>• Each component of a detailed SOW with real-world examples.<br><br>**Demonstration**<br>Show students how to documents and format it professionally<br>**Case study** | **The students should be able to explain how to:**<br>• Prepare electrical lay-out drawing.<br>• Prepare technical specification of the materials.<br>• Prepare brochures of the identified material. | Detailed scope of work is prepared as guideline. | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Short list tenderer.<br>• Prepare tender document.<br>**Principles:** The students should explain the principles of preparing the tender documents.<br>**Theories:** The students should explain the difference between short listed tender and open tender. | The following tools, safety gear and equipment are to be available:<br>• Stationery.<br>• Building machine.<br>• Staple machine.<br>• Electrical plan-lay-out.<br>• Schematic wiring diagram.<br>• Brochures of materials. | 8 |

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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | Prepare a case study on installing solar power in the workshop | | | | | |
| | | (b) Preparing the cost estimate of the work | **Discussion**<br>Guide the students to discuss<br>• Aspects of cost estimation.<br>• the components involved and the various methods of estimating costs.<br>• Present examples of cost estimation for different types of projects<br>**Demonstration**<br>Show students how to use cost estimation tools (e.g., Excel templates, software).<br>**Practice**<br>Guide the students practice | **The students should be able to explain how to:**<br>• Prepare technical specification of the materials.<br>• Prepare bills of quantities for the tender (BOQ).<br>• Prepare related documents (Instruction to tenderer, special conditions of contract).<br>• Prepare brochures of the identified material.<br>• Bind the document.<br>• Cross check the contents of the tender document<br>• Advertise the tender | A tender document is prepared with all contents. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Prepare short listed tender document.<br>• Prepare open tender document.<br>**Principles:** The students should explain the principles of preparing the tender documents.<br>**Theories:** The students should explain:<br>• The difference between short listed tender and open tender.<br>• Application of the short listed and open tenders.<br>• Public procurement Agency | The following tools, safety gear and equipment are to be available:<br>• Stationery.<br>• Building machine.<br>• Staple machine.<br>• Electrical plan-lay-out.<br>• Schematic wiring diagram.<br>• Brochures of materials.<br>• Overcoat.<br>• Safety boots.<br>• Safety gloves.<br>The following tools, safety equipment should be available:<br>• Stationery.<br>• Building machine.<br>• Staple machine.<br>• Electrical plan-lay-out.<br>• Schematic wiring diagram.<br>• Brochures of materials. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | project cost estimation | | | | | |
| | 6.4 Training subordinates | (a) Conducting training need assessment (TNA) | **Discussion**<br>Guide the students to discuss<br>• The purpose and steps of conducting a TNA.<br>• Various methods of data collection and how to analyse results.<br>**Demonstration**<br>Show students how to<br>• Prepare survey templates, interview questions, and performance review forms used in TNA.<br>• Analyse data and identify training gaps.<br><br>**Case study** | **The students should be able to explain how to:**<br>• Prepare training assessment tools.<br>• Assess workers using specified tool<br>• Prepare a training programme for the subordinate. | Training need assessment is conducted as per required standards and regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to prepare training programme.<br><br>**Principles:** The students should explain the principles of carrying out training programme<br><br>**Theories:** The students should explain:<br>• Previous knowledge and skill of the person to be trained.<br>• The importance of training. | The following tools, safety gear and equipment are to be available:<br>• Electrical tool kit.<br>• Clamp-on meter.<br>• multimeter.<br>• Megger.<br>• Work bench.<br>• Safety goggles.<br>• Safety boots.<br>• Safety gloves.<br>• Overcoat. | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | Prepare a story which will guide the students to identify training requirement | | | | | |
| | | (b) Estimating budget for conducting training | **Discussion**<br>Guide the students to discuss<br>• Importance of budgeting for training programmes.<br>• Categories that make up a training budget.<br>• Calculation of estimates for each category and how to add them up to form the final budget.<br><br>**Activities**<br>Provide students with a case study where they have to estimate the budget for a | **The students should be able to how to:**<br>• Prepare training chart of the subordinates.<br>• Prepare a training programme for the subordinate.<br>• Prepare training logistic and budget | Budget for conducting training is estimated as requirements | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to prepare budget for training programme.<br><br>**Principles:** The students should explain the principles of preparing training programme budget estimates.<br><br>**Theories:** The students should explain:<br>• Financial management<br>• Importance of training to subordinate. | The following tools, safety gear and equipment are to be available:<br>• Electrical tool kit.<br>• Clamp-on meter.<br>• Digital multimeter.<br>• Analogue multimeter.<br>• Megger.<br>• Work bench.<br>• Safety goggles.<br>• Safety boots.<br>• Safety gloves.<br>• Overcoat. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | training program. | | | | | |
| | | (c) conducting training to subordinates | **Discussion**<br>Guide the students to discuss<br>• Training concepts, methods, and tools.<br>• The skills or processes you want them to learn<br>**Role-playing and Simulation**<br>• Use role-playing scenarios to simulate real work situations that subordinates may encounter.<br>• Assign roles to different participants and have them act out different responses to practice communication, problem- | **The students should be able to explain how to:**<br>• Prepare a training programme<br>• Carry out the training programme<br>• Make adjustments to training programme if necessary.<br>• Assess the training progress<br>• Clean the work area.<br>• Store tools, equipment, safety gear and other items. | Training to subordinates is conducted as per schedule | **Knowledge evidence:**<br>**Detailed knowledge of:**<br>**Method used:** The students should explain how to conduct training programme.<br><br>**Principles:** The students should explain the principles of carrying out training programme<br><br>**Theories:** The students should explain:<br>• Importance of skills upgrading<br>• Delegation of duties and responsibilities | The following tools, safety gear and equipment are to be available:<br>• Electrical tool kit.<br>• Clamp-on meter.<br>• multimeter.<br>• Megger.<br>• Work bench.<br>• Safety goggles.<br>• Safety boots.<br>• Safety gloves.<br>• Overcoat. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | solving, or decision-making skills. | | | | | |
| | 6.5 Supervising subordinates | (a) Preparing motivation scheme. | **Case Study**<br>Guide the students to<br>Use real-life case studies of successful motivation schemes within organizations to illustrate how a motivation plan can enhance employee performance.<br><br>**Discussion**<br>Guide the students to discuss the key components of the motivation schemes and how they can be adapted to different workplace settings.<br>**Role-Playing**<br>Guide the students to simulate scenarios | **The students should be able to explain how to:**<br>• Maintain discipline in working area<br>• Coordinate the staff at various levels.<br>• Improve communication among workers.<br>• Manage tools and materials<br>• Pay salaries, wages and incentive timely. | Motivation scheme is prepared as per regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Manage working environment.<br>• Fill up a job card.<br><br>**Principles:** The students should explain the principles of:<br>• Scientific management.<br>• Collective decision making strategies<br>**Theories:** The students should explain:<br>• Types of management objectives.<br>• Managerial abilities. | The following tools, safety gear and equipment are to be available:<br>• Job cards.<br>• Work schedule sheets.<br>• Drawing facilities.<br>• Plan layout.<br>• Overcoat.<br>• Helmet.<br>• Safety boots. | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | where employees request different types of rewards or recognition, allowing them to practice handling these requests professionally. | | | | | |
| | | (b) Preparing work schedule. | **Case study Guide the students to c**hoose realistic and relatable scenarios for the students. Possible scenarios include scheduling for a project team, a retail store, or a hospital shift.<br><br>**Role-playing**; guide the students to choose realistic and relatable scenarios for the students including scheduling for a | **The students should be able to explain:**<br>• Job description of each employees<br>• Institutional culture<br>• Staff coordination strategies<br>• Suggest improvements.<br>• Keeping tools and materials.<br>• Timely instruction-and consistent guidance.<br>• Importance of facilities and timely payment of the workers. | Work schedule is prepared as per regulation. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Prepare Work schedule<br>• Fill up a job card.<br>• Manage tools, materials<br><br>**Principles:** The students should explain the principles of:<br>• Scientific management.<br>• Managerial management.<br>**Theories:** The students should explain:<br>• Types of management objectives. | The following tools, safety gear and equipment are to be available:<br>• Job cards.<br>• Work schedule sheets.<br>• Drawing facilities.<br>• Plan layout.<br>• Overcoat.<br>• Helmet.<br>• Safety boots. | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | project team, a retail store, or a hospital shift | | | • Managerial abilities | | |
| 7.0 Managing safe work environment | 7.1 Managing hazards | (a) Controlling engineering hazards | Hazard Identification Guide the students to<br>• Identifying potential hazards in a simulated engineering environment<br>• Prepare assessment tools to determine the level of risk and propose control measures.<br><br>Field Trips and Site Visits; Organise students to visits nearby industry to study how do they control hazard<br><br>**Guest Lectures and Expert Panels;** | **The students should be able to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Use OSHA rules and regulations<br>• Prepare workshop inspection report<br>• Prepare workshop colour codes and safety signs<br>• Identify hazard materials<br>• Handle hazards material<br>• Conduct safety awareness training to sub-ordinates<br>• Monitor safety environment<br>• Manage uses of safety gear<br>• Cleaning tools and equipment<br>• Storing tools and equipment | Engineering hazards is controlled as per OSHA rules and regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Interpret OSHA rules and regulations<br>• Use of safety gear<br>• Prepare preventive maintenance schedule and inspection report<br>• Prepare warning signs and safety instructions<br>• Conduct assessment<br>• Carry out accident investigation<br>• Monitor safe working environment<br>• Manage uses of safety gear<br><br>**Principles:** The students should | The following tools, safety gear and equipment are to be available:<br><br>• Electrical equipment<br>• Mechanical equipment<br>• Power machines<br>• Measuring tools<br>• Cutting tools<br>• First aid kit<br>• Fire extinguishers<br>• Service manuals<br>• OSHA rules and regulations<br>• Helmet<br>• Gloves<br>• Ear plug<br>• Mask<br>• Gloves | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | Invite team of experts particularly from government Agency for students to learn | | | explain the principles of:<br>• Preparing inspection check lists<br>• Preparing warning signs and safety instructions<br>• Identifying hazards materials<br>• Preparing and conducting safety training<br>• Handing hazard materials<br><br>**Theories:** The students should explain:<br>• Function of inspection check list<br>• Importance of warning sign and safety instructions<br>• Advantages of risk assessment<br>• Importance of carry out accident investigation<br>• Importance of monitor safety at working place | | |
| | | (b) Controllin | **Case Study** | **The students should** | Chemical | **Knowledge evidence:** | The following tools, | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | g chemical hazards | Guide the students to analysis the case study involving a chemical hazard incident, and ask students to analyse what went wrong and how hazard control measures could have been implemented.<br>**Demonstration**<br>Show students how to use personal protective equipment for chemical hazards, such as gloves, respirators, and goggles. | **be able to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Use OSHA rules and regulations<br>• Prepare workshop inspection report<br>• Prepare workshop colour codes and safety signs<br>• Identify any hazard materials<br>• Handle hazards material<br>• Conduct safety awareness training to sub-ordinates<br>• Monitor safety environment<br>• Manage uses of safety gear<br>• Cleaning tools and equipment<br>• Storing tools and equipment | hazards are controlled as per OSHA rules and regulations. | **Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Interpret OSHA rules and regulations<br>• Use safety gear<br>• Prepare preventive maintenance schedule and inspection report<br>• Prepare warning signs and safety instructions<br>• Monitor safe working environment<br>• Manage uses of safety gear<br><br>**Principles:** The students should explain the principles of:<br>• Preparing inspection check lists<br>• Preparing warning signs and safety instructions<br>• Identifying | safety gear and equipment are to be available:<br><br>• Electrical equipment<br>• Mechanical equipment<br>• Power machines<br>• Measuring tools<br>• Cutting tools<br>• First aid kit<br>• Fire extinguishers<br>• Service manuals<br>• OSHA rules and regulations<br>• Helmet<br>• Gloves<br>• Ear plug<br>• Mask<br>• Gloves | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | | | | hazards materials<br>• Preparing and conducting training<br>• Handing hazard materials<br><br>**Theories:** The students should explain:<br>• Function of inspection check list<br>• Importance of posting warning sign and safety instructions<br>• Advantages of risk assessment<br>• Importance of carry out accident investigation<br>• Importance of monitor safety at working place | | |
| | 7.2 Carrying out risk assessment | (a) Identifying risks at working environment | **Discussion**<br>Guide the students to discuss<br>• Types of risks in a variety of workplaces (e.g., factories, | **The students should be able to:**<br>• Interpret service manuals<br>• Select tools and equipment<br>• Identify risks<br>• Make periodic | Risk at working environment is identified as per OSHA standard and automobile regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Conduct safety training<br>• Identify safety | The following tools, safety gear and equipment are to be available:<br><br>• Service manuals<br>• OSHA regulations<br>• Workshop rules | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | offices, healthcare settings).<br>• possible risks they encounter in their daily work environments and propose ways to control them.<br>**Group activities**<br>Guide the students to research and present potential risks and control measures related to their assigned hazard. | inspections of workshop<br>• Conduct safety training<br>• Prepare universal workshop colour codes a<br>• Ensure availability of personal protective equipment<br>• Monitor good environmental practices<br>• Clean tools and equipment<br>• Store tools and equipment | | hazard material<br>• Handle hazard material<br>• Prepare inspection report<br><br>**Principles:** The students should explain the principles of:<br>• Reacting correctly and safely when faced with an emergency<br>• Conducting safety training<br>• Identifying safely hazard materials<br>• Handling hazard materials<br><br>**Theories:** The students should explain:<br>• Conducting safety training<br>• Inspecting workshop<br>• Handling Hazard material | • Camera<br>• Risk assessment sheet<br>• Mask<br>• Ear plug<br>• Gloves<br>• Overall<br>• Safety boots<br>• Safety clear glasses | |
| | | (b) Mitigating risk at working environme | **Discussion**<br>Guide the students to discuss the | **The students should be able to:**<br>• Interpret service manuals | Risk at working environment is mitigated | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The | The following tools, safety gear and equipment are to be available: | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | nt | effectiveness of different mitigation strategies that could have been used (e.g., substitution, engineering controls, PPE).<br><br>**Group Activities**<br>Guide students to analyse different type of workplace risk (e.g., chemical, physical, electrical, biological). | • Select tools and equipment<br>• Make periodic inspections of workshop<br>• Conduct safety training<br>• Prepare universal workshop colour codes<br>• Emphasize the use of personal protective equipment<br>• Monitor good environmental practices<br>• Clean tools and equipment<br>• Store tools and equipment | as per OSHA standard and automobile regulations. | students should explain how to:<br>• Conduct safety training<br>• Identify safety hazard material<br>• Handle hazard material<br>• Prepare inspection report<br><br>**Principles:** The students should explain the principles of:<br>• Handle emergency cases<br>• Conducting safety training<br>• Identify hazard materials<br>• Handling hazard materials<br><br>**Theories:** The students should explain:<br>• Conducting safety training<br>• Inspecting workshop<br>• Handling Hazard material | • Service manuals<br>• OSHA regulations<br>• Workshop rules<br>• Camera<br>• Risk assessment sheet<br>• Mask<br>• Ear plug<br>• Gloves<br>• Overall<br>• Safety boots<br>• Safety clear glasses | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
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| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | 7.3 Managing environment | (a) Managing air pollution | **Discussion**<br>Guide the students to discuss the different types of pollutants, their sources, and their impact on health and the environment.<br>**Case Study Analysis**<br>Provide students with case studies of regions or cities that have successfully reduced air pollution | **The students should be able to:**<br>• Select relevant safety gear<br>• Control air pollution<br>• Maintain safe environment<br>• Manage safety personal environment<br>• Control tools, equipment and safety gear<br>• Control different types of wastes as per OSHA<br>• Conduct safety awareness training to subordinates<br>• Clean tools and equipment<br>• Store tools and equipment | Air pollution is managed as per rules and regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should explain how to:<br>• Interpret OSHA rules and regulations<br>• Prepare preventive maintenance schedule and inspection report<br>• Monitor safe working environment<br>• Control environment pollution<br>• Control different types of wastes<br>• Manage uses of safety gear<br><br>**Principles:** The students should explain the principles of:<br>• Managing environment pollution<br>• Handling environmental | The following tools, safety gear and equipment are to be available:<br>• Tool kit<br>• Sprit level<br>• Multimeter<br>• Safety boots<br>• Gloves<br>• Overalls<br>• Cleaning materials<br>• Hoe<br>• Broom<br>• Brush<br>• Safety gear<br>• Dust covers<br>• Dust mask<br>• Dust bin<br>• Wheel barrow | 8 |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | | | | safety work<br>• Preparing and conducting training<br>• Handling different types of wastes<br><br>**Theories:** The students should explain: -<br>• Students should explain importance of safe work environment<br>• Explain types of environment pollution<br>• Advantages of monitoring environmental pollution<br>• Importance of preparing environmental schedule<br>• Importance of control different types of wastes | | |
| | | (b) Managing water pollution | **Case study** guide the students to choose realistic and relatable scenarios for the | **The students should be able to:**<br>• Select relevant safety gear<br>• Control | Water pollution is managed as per rules and regulations. | **Knowledge evidence: Detailed knowledge of:**<br>**Method used:** The students should | The following tools, safety gear and equipment are to be available: | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | students.<br>Possible scenarios include scheduling for a project team, a retail store, or a hospital shift.<br><br>**Role-playing**; guide students to choose realistic and relatable scenarios for the student's water pollution management. | environmental pollution<br>• Carry work without polluting source of water<br>• Managing safety personal environment<br>• Control tools, equipment and safety gear<br>• Control different types of wastes as per OSHA<br>• Conduct safety awareness training to subordinates<br>• Clean tools and equipment<br>• Store tools and equipment | | explain how to:<br>• Interpret OSHA rules and regulations<br>• Monitor safe working environment<br>• Control environment pollution<br>• Control different types of wastes<br>• Manage uses of safety gear<br><br>**Principles:** The students should explain the principles of:<br>• Managing environment pollution<br>• Handling environmental safety work<br>• Preparing and conducting training<br>• Handling different types of wastes<br><br>**Theories:** The students should explain: - | • Tool kit<br>• Sprit level<br>• Multimeter<br>• Safety boots<br>• Gloves<br>• Overalls<br>• Cleaning materials<br>• Hoe<br>• Broom<br>• Brush<br>• Safety gear<br>• Dust covers<br>• Dust mask<br>• Dust bin<br>• Wheel barrow | |

| Module Title (Main Competence) | Unit Title (Specific Competences) | Elements (Learning Activities) | Suggested Teaching and Learning Methods | Assessment Criteria | | | Training Requirements/ Suggested Resources | Number of Periods per Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | Process Assessment | Services Assessment | Knowledge assessment | | |
| | | | | | | • Students should explain importance of safe work environment<br>• Explain types of environment pollution<br>• Advantages of monitoring environmental pollution<br>• Importance of preparing environmental schedule<br>• Importance of control different types of wastes | | |

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