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ELECTRICAL EQUIPMENT INSTALLATION AND REPAIR

CBT Curriculum

National Vocational
Certificate Level 2

Version 1 - December 2014



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1. Introduction

The construction industry is one of the leading businesses in Pakistan as well as in Middle East and other parts of the world. The Electrical Equipment Installer & Repairer plays a vital role in installation and maintenance of electrical appliances. The use of electrical appliances has increased manifold over the last few decades. The maintenance of these appliances has created an opportunity for skill training in this field.

1.1 Overall course objective

The aim of this programmed is to produce employable Electrical Equipment Installer & Repairer who could provide installation and maintenance services of electrical appliance. In addition, this programme aims to prepare unemployed youth to find employment in the construction industries or to enable them in becoming successful as entrepreneur.

1.2 Course competencies

After completion of training the trainees will be able to:

- Developed professionalism associated with the electrical installer and repairer trade;
- Maintain Safety;
- Interpret Drawings;
- Maintain Tools & Equipment;
- Install Wiring;
- Perform Installations and Assembling of Electrical Appliance / items;
- Perform product testing;
- Perform Preventive and Corrective Maintenance;
- Perform Quality Checks; and
- Maintain Documentation.

1.3 Job opportunities

The pass out of this course would be able to:

- Work in small & big construction units as electrical installer and repairer
- Work as electrical installer and repairer in an electrical outfit / company / organization
- Work as electrical installer and repairer with construction contractor
- Be self employed by having his own electrical / wiring workshop

1.4 Trainee entry level

Individuals who wish to enter this course of study have to comply against the following criteria:

- Grade 8 (Middle) or equivalent;
- Comfort level of English language and mathematics;
- Satisfactory completion of appropriate admission assessment test.
- Satisfactory complication of electrical equipment repair & installer (Level 1)

1.5 Minimum qualification of trainer

Trainers who wish to offer this programme should meet one of the following requirements:

- B.Sc. Eng and 2 years of relevant work experience; or
- B-Tech and 4 years of relevant work experience; or
- Diploma Associate Engineer (DAE) and 5 years relevant work experience; or
- Certificate issued by authentication institute or organization as Electrical Equipment Installer & Repairer with 8 years relevant work experience

Trainers offering this programme must be computer literate and be conversant with the delivery of competency-based education and training (CBET). All legislative requirements applicable to carry out training and assessment, if any, must be complied with.

1.6 Teaching strategies in a competency-based environment

Training in a competency-based environment differs from the traditional method of training delivery. It is based on defined competency standards, which are industry oriented.

The traditional role of a trainer changes and shifts towards the facilitation of training. A facilitator in CBET encourages and assists trainees to learn for themselves. Trainees are likely to work in groups (pairs) and all doing something different. Some are doing practical tasks in the workshop, some writing, some not even in the classroom or workshop but in another part of the building using specialist equipment, working on computers doing research on the Internet or the library. As trainees learn at different pace they might well be at different stages in their learning, thus learning must be tailored to suit individual needs.

The following facilitation methods (teaching strategies) are generally employed in CBET programmes:

- **Direct Instruction Method:** This might be effective when introducing a new topic to a larger group of trainees in a relative short amount of time. In most cases this method relies on one-way communication, hence there are limited opportunities to get feedback on the trainee's understanding.
- **Discussion Method:** This allows trainees to actively participate in sharing knowledge and ideas. It will help the trainer to determine whether trainees understand the content of the topic. On the other hand, there is a possibility of straying off topic under discussion and some trainees dominating others on their views.
- **Small Group Method:** Pairing trainees to help and learn from each other often results in faster knowledge/skill transfer than with the whole class. The physical arrangement of the classroom/workshop and individual assessment may be challenging.
- **Problem Solving Method:** This is a very popular teaching strategy for CBET. Trainees are challenged and are usually highly motivated when they gain new knowledge and skills by solving problems (Contingency skills). Trainees develop critical thinking skills and the ability to adapt to new learning situations (Transfer skills). It might be time consuming and because trainees sometimes work individually, they may not learn all the things that they are expected to learn.
- **Research Method:** This is used for workshops and laboratory tasks, field experiments, and case studies. It encourages trainees to investigate and find answers for themselves and to critically evaluate information. It however requires a lot of time and careful planning of research projects for the trainee.

1.7 Medium of instructions

- Urdu, local languages and/or English

1.8 Sequence and delivery of the modules

The curriculum for Electrical Equipment Installer&Repairer (Assistant) – NVQF level 2, consists of five (5) modules. The delivery of the modules (sequence) is suggested as follows:

Module 1: Electrical Theory

Module 2: Maintenance

Module 3: Installation and Assembling

Module 4: Testing and troubleshooting

Module 5: Continuing Professional Development

Learning units within these modules can be delivered interchangeably as stand-alone modules or in an integrated approach.

1.9 Duration of the course

The proposed curriculum is composed of 5 modules, which will be delivered over 1600 hours i.e. one (1) year.

The distribution of training hours is as follows:

a) Total Training hours	=	1600 Hours
b) Theory	=	320 Hours (20%)
c) Practical	=	1280 Hours (80%)

2. Overview about the programme – Curriculum for Electrical Equipment Installer & Repairer (Assistant) – NVQF Level 2:

Module Title	Learning Units	Theory ¹ Days/hours	Workplace ² Days/hours	Timeframe of modules
Module 1: Electrical Theory	<p>LU-1: Describe basic electrical concepts</p> <p>LU-2: Identify hazards associated with electricity</p> <p>LU-3: Describe sources of electricity generation</p> <p>LU-4: Calculate electrical variables</p> <p>LU-5: Describe electrical quantities measurement instruments and Perform measurements in electrical circuits</p> <p>LU-6: Demonstrate knowledge of electric power</p> <p>LU-7: Describe resistive, inductive and capacitive loads</p> <p>LU-8: Describe basic magnetic principles</p>	82	46	128
Module 2: Maintenance	<p>LU-1: Plan and prepare for work</p> <p>LU-2: Use tools and equipment</p> <p>LU-3: Inspect and troubleshoot system</p> <p>LU-4: Conduct preventive and corrective maintenance</p>	53	474	527

¹Learning hours in training provider premises

²Training workshop, laboratory and on-the-job workplace

Module 3: Installation and Assembling	LU-1: Plan and prepare for work LU-2: Install machines and appliances LU-3: Perform operational testing	89	440	529
Module 4: Testing and troubleshooting	LU-1: Demonstrate diagnostic procedure LU-2: Remove Fault	75	320	395
Module 5: Continuing Professional Development	LU-1: Identify professional development needs LU-2: Develop professional knowledge, skills and attitudes LU-3: Maintain professional proficiency	21	0	21

3. Electrical Equipment Installer & Repairer(Assistant) – Curriculum Contents

Module 1:	Electrical Theory					
Objective of the Module:	<p>On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements:</p> <ul style="list-style-type: none"> • Describe basic electrical concepts • Identify hazards associated with electricity • Describe sources of electricity generation • Calculate electrical variables • Perform measurements in electrical circuits • Demonstrate knowledge of electric power • Describe resistive, inductive and capacitive loads • Describe basic magnetic principles 					
Duration:	Total:	128 hours	Theory:	82 hours	Practice:	46 hours
Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place	
LU-1: Describe basic electrical concepts	1.1 Demonstrate knowledge of electron theory	<ul style="list-style-type: none"> • Definition of matter • Different states of matter with examples • Definition of atom, molecule and element • Atomic structure and shells • Description of proton, electron and neutron • Definition of valence and free electrons • Properties of positive and negative charge • Definition of electricity 	Total 35Hrs Theory 25Hrs Practical 10 Hrs	Non Consumable <ul style="list-style-type: none"> • Oscilloscope • Digital clamp meter • Generator Consumable <ul style="list-style-type: none"> • Analogue meter • Analogue voltmeter • Animation of atomic model • Animation of states of matter 	Theory Classroom Practical Lab Workshop	

	1.2 Describe current flow	<ul style="list-style-type: none"> • Conventional current and electron flow theory • Static and dynamic charge 		<ul style="list-style-type: none"> • Atomic model • Balloon • Batteries • Clamp meter • Conductor • Digital multi meter • Electric fan • Electric heater • Permanent and temporary magnets 	
	1.3 Define conductor, semi-conductor and insulator	<ul style="list-style-type: none"> • Properties of conductors, insulators and semiconductors • Types of diodes, e.g. <ul style="list-style-type: none"> - Photodiode - LED and Rectified Diode - Blocking diode 			
	1.4 Apply Ohm's law for DC circuits	<ul style="list-style-type: none"> • Definition • Laws of resistance • Relation between current (I), voltage (V) and resistance (R) 			
	1.5 Describe factors affecting resistance of conductors	<ul style="list-style-type: none"> • Definition of resistivity • Resistivity of materials • Factors affecting resistance of conductors • Calculating resistance of a conductor with regard to cross sectional area, length, resistivity and operating temperature 			

LU-2: Identify hazards associated with electricity	2.1 Describe electricity hazards	<ul style="list-style-type: none"> • Common electricity hazards <ul style="list-style-type: none"> - Insulation breaks of cable - Guarding or identification of live parts - Grounding - Electric spark due to increased load - Lack of protection equipment uses - Unawareness 	Total 08Hrs Theory 05Hrs Practical 03Hrs	Theory Classroom Practical Lab Workshop
	2.2 Apply the protection procedures for electric shock	<ul style="list-style-type: none"> • De energizing electric equipment before inspection or repair • Maintaining electric tools • Working near energized lines • Using protective equipment 		
	2.3 Identify safety signs and symbols associated with electricity hazards	<ul style="list-style-type: none"> • Different safety signs and symbols 		

LU-3: Describe sources of electricity generation	3.1 Identify sources of electricity generation	<ul style="list-style-type: none"> • Sources of electricity generation <ul style="list-style-type: none"> - Static electricity - Electromagnetic induction - Electrochemistry - Photovoltaic effect - Thermoelectric effect - Piezoelectric effect - Nuclear transformation 	Total 15Hrs Theory 10 Hrs Practical 05Hrs		Theory Classroom Practical Lab Workshop
	3.2 Nature of electricity (AC or DC) produced by different sources ----- 3.2 Describe Motor, Generator and their relation.	<ul style="list-style-type: none"> • Definition of AC and DC electricity • Varying/sinusoidal nature of current and voltage in AC • Non-varying/uniform nature of current and voltage in DC • Importance of polarity in DC circuits • Define Motor • Define Generator • Relationship between motor and generator 			

LU-4: Calculate electrical variables	4.1 Demonstrate knowledge of series-, parallel-, and series/parallel electrical circuits	<ul style="list-style-type: none"> • Circuit layout <ul style="list-style-type: none"> - Series - Parallel - Series/Parallel • Circuit characteristics <ul style="list-style-type: none"> - Voltage - Current - Resistance • Fault finding procedures 	Total 15Hrs Theory 10 Hrs Practical 05Hrs		Theory Classroom Practical Lab Workshop
	4.2 Calculate electrical quantities in DC circuits based on Ohm's Law	<ul style="list-style-type: none"> • Ohm's law wheel <ul style="list-style-type: none"> - Calculating voltage - Calculating current - Calculating resistance - Calculating power 			
	4.3 Calculate electrical quantities in AC circuits based on Ohm's law	<ul style="list-style-type: none"> • Ohms' Law for AC circuits • Ohms' Law for DC circuits 			

LU-5: Perform measurements in electrical circuits	5.1 Identify digital and analogue instruments	<ul style="list-style-type: none"> • Definition and examples of analogue display instruments • Function of digital clamp meter 	Total 20Hrs Theory 08Hrs Practical 12Hrs		
	5.2 Measure current and voltage in DC and circuits	<ul style="list-style-type: none"> • Measuring current and voltage in DC and AC circuits • Defining electrical parameters, such as V_{OC}, V_{max}, I_{SC}, V_{rms}, V_{peak}, $V_{peak-peak}$, I_{rms} 			
	5.3 Measure frequency of grid electricity	<ul style="list-style-type: none"> • Functioning of oscilloscope • Measuring frequency of grid electricity using oscilloscope 			
	5.4 Measure real and apparent power	<ul style="list-style-type: none"> • Definition of real, apparent and reactive power • Relationship between real, apparent and reactive power • Units of real/active, apparent and reactive power • Measuring real and apparent power 			
	5.5 Measure voltage and frequency of single and three phase grid electricity	<ul style="list-style-type: none"> • Measuring single phase voltage of grid electricity • Measuring three phase voltage of grid electricity • Measuring frequency of grid electricity 			

LU-6: Demonstrate knowledge of electric power	6.1 Describe the different ratio for real power, apparent power and reactive power	<ul style="list-style-type: none"> • Power triangle • Pythagoras theorem • Calculation of angle 	Total 15Hrs Theory 10 Hrs Practical 05Hrs		
	6.2 Define the terms KVA, KVAR and KW	<ul style="list-style-type: none"> • Definition of KVA, KVAR and KW 			
	6.3 Measure power factor of grid electricity	<ul style="list-style-type: none"> • Calculate value of reactive power • Definition of power factor • Measuring power factor of main AC line 			
	6.4 State the advantages and disadvantages of low power factor and high power factor	<ul style="list-style-type: none"> • KVA rating • Per unit cost • Power loss • High current • Increases expenses 			
	6.5 Explain the causes of low power factor and techniques to improve it	<ul style="list-style-type: none"> • Causes of low power factor • Disadvantages of low power factor • Techniques to improve power factor 			

LU-7 Describe resistive, inductive and	7.1 Define resistance, capacitance and inductance	<ul style="list-style-type: none"> • Definition of resistance, capacitance and inductance • Units and symbols 	Total 08Hrs		
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capacitive loads		<ul style="list-style-type: none"> • Parallel and series operation of inductors and capacitors 	Theory 06Hrs Practical 02Hrs		
	7.2 Differentiate between resistive, inductive and capacitive loads	<ul style="list-style-type: none"> • Examples of resistive loads • Examples of inductive loads • Examples of capacitive load 			
	7.3 Explain importance of electrostatic discharge (ESD)	<ul style="list-style-type: none"> • Definition of ESD • Adverse effects of ESD 			
LU-8: Describe basic magnetic principles	8.1 Define permanent and temporary magnets	<ul style="list-style-type: none"> • Definition 'permanent magnets' • Definition 'temporary magnets' 	Total 12Hrs Theory 08Hrs Practical 04Hrs		
	8.2 Define the term 'flux'	<ul style="list-style-type: none"> • Definition 'flux' 			
	8.3 Describe magnetic lines of force and list their characteristics	<ul style="list-style-type: none"> • Magnetic flux • Flux density 			
	8.4 Apply the fundamental laws of magnetism	<ul style="list-style-type: none"> • Fleming's hand rules • Lenz's law 			

Module 2:	Maintenance					
Objective of the Module:	<p>On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements:</p> <ul style="list-style-type: none"> • Plan and prepare for work • Use tools and equipment • Inspect and troubleshoot systems • Conduct maintenance 					
Duration:	Total:	338 hours	Theory:	48 hours	Practice:	290 hours
Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place	
LU-1: Plan and prepare for work	1.1 Identify and obtain safety and other regulatory requirements for maintenance	<ul style="list-style-type: none"> • Safety requirements, specifications, Hazard identification 	Total 23 Hrs	Non Consumable <ul style="list-style-type: none"> • Personal protective equipment • Tools and equipment 	Theory Classroom	
	1.2 Interpret circuit diagrams	<ul style="list-style-type: none"> • Drawings and symbols specifications 	Theory 03 Hrs		Practical Lab	
	1.3 List the tools are required for plan and prepare of work	<ul style="list-style-type: none"> • Tools and equipment and calibration thereof 	Practical 20 Hrs	Consumable <ul style="list-style-type: none"> • Drawing sheets • Lead Pencil • Clip board 	Workshop Local industry	

LU-2: Use tools and equipment	2.1 Identify and select tools, equipment and instruments for maintenance	<ul style="list-style-type: none"> • Purpose of tools, equipment and instruments 	Total 45Hrs	Non Consumable <ul style="list-style-type: none"> • Electrical tools and machine • Oscilloscope • Generator 	Theory Classroom					
	2.2 Demonstration safe use of tools and equipment	<ul style="list-style-type: none"> • Use of electrical tools, equipment & instruments 				Theory 05Hrs	Practical Lab			
	2.3 Describe preventive maintenance procedures	<ul style="list-style-type: none"> • Preventive maintenance <ul style="list-style-type: none"> - Tools - Equipment - Instruments - Machinery - Facilities 						Practical 40 Hrs	Consumable Workshop	
	2.4 Maintain and / or replace tool insulation	<ul style="list-style-type: none"> • Types of insulation and reports 								Consumable Local industry
	2.5 Clean and store electrical tool insulation	<ul style="list-style-type: none"> • Storage requirements 								
	2.6 Define the following term	<ul style="list-style-type: none"> • Electrolyte • Error • Zero error • Calibration 								
	2.7 Explain key hazards associated with use of tools and equipment	<ul style="list-style-type: none"> • Cut on any part of body • Slipping of tools and equipment • Bleeding • First aid 								
	2.8 Identify the state of charge and types of batteries	<ul style="list-style-type: none"> • Static • Dynamic • Positive charge • Negative charge • Types of batteries 								

	2.9 Maintain electrolyte level	<ul style="list-style-type: none"> • Role of electrolyte 			
	2.10 Describe the procedure for charging batteries	<ul style="list-style-type: none"> • Charging procedures 			
	2.11 Apply the procedure for calibrating measuring instruments	<ul style="list-style-type: none"> • Types and methods of calibration 			
	2.12 Document and interpret calibration	<ul style="list-style-type: none"> • Types of calibration reports 			
	2.13 Calibrate measuring instrument	<ul style="list-style-type: none"> • Types and methods of calibration • International standards 			
	2.14 List the problem that may occur when do calibrating	<ul style="list-style-type: none"> • Adjusting error • Personal error • Technical error • Equipment error • International standards • Calibrating techniques 			
LU-3: Inspect and troubleshoot systems	3.1 List the key safety hazards associated with troubleshooting	<ul style="list-style-type: none"> • Inspection requirements • Troubleshooting requirements 	Total 85 Hrs	Non Consumable <ul style="list-style-type: none"> • Mega meter • Earth test meter • Synchronize meter • Clamp on meter • Oscilloscope • Pliers 	Theory Classroom Practical Lab Workshop Local industry
	3.2 Describe the procedures for routine check	<ul style="list-style-type: none"> • Maintenance of electrical instruments and equipment; Types of common faults of wiring; Load balance; Safety precautions 	Theory 15 Hrs Practical 70 Hrs		
	3.3 Define the terms	<ul style="list-style-type: none"> • Troubleshooting • Fault • Loads 		<ul style="list-style-type: none"> • Wire cutter • Screw drivers 	

		<ul style="list-style-type: none"> • Schedule inspection 			
	3.4 State the document results	<ul style="list-style-type: none"> • Test and preventive reports 		Consumable <ul style="list-style-type: none"> • Handouts • Safety hazards • Compass • Extension board 	
	3.5 States the remedies for un-balance system	<ul style="list-style-type: none"> • Natural phase fault • Low power factor • Short circuit • Phase Unbalance • Grounding • Leakage current • Low quality material 			
	3.6 Apply the diagnostic procedures for troubleshooting	<ul style="list-style-type: none"> • Identification of electrical faults by checking shape, size and colour of components and parts; Measurement of electrical parameters; Safety precautions 			
	3.7 Identify faulty parts and / or equipment	<ul style="list-style-type: none"> • Methods of fault identification in electrical components 			
	3.8 Analyze system fault	<ul style="list-style-type: none"> • System operations in an electrical environment 			
	3.9 List the tools for required troubleshooting	<ul style="list-style-type: none"> • Calibration tools • Testing tools • Operational tools • Personal protective tools 			

LU-4: Conduct maintenance	4.1 Explain the key hazards associated with maintenance	<ul style="list-style-type: none"> Identify and obtain safety, hazards and other regulatory requirements for conduct maintenance 	Total 95 Hrs	Non Consumable <ul style="list-style-type: none"> Bench wise Battery charger Pipe wrench Hand drill machine Goggles File set L Key set Mega meter Earth test meter Synchronize meter Clamp on meter Oscilloscope Hand tool set Consumable <ul style="list-style-type: none"> Handouts Safety hazards Charge controller Hydrometer Torch Wire gauge Compass 	Theory Classroom Practical Lab Workshop Local industry
	4.2 Describe basic measurements tests	<ul style="list-style-type: none"> Measurement and calculation of electrical parameters 	Theory 15 Hrs		
	4.3 Apply minor adjustments and calibrations	<ul style="list-style-type: none"> Adjustment techniques for electrical equipment and components; Calibration methods 	Practical 80 Hrs		
	4.4 Replace worn out or damaged parts	<ul style="list-style-type: none"> Identification of worn out or damaged parts 			
	4.5 Describe the procedures of dismantle faulty parts or components	<ul style="list-style-type: none"> Dismantling procedures 			
	4.6 Replace or repair faulty parts or components	<ul style="list-style-type: none"> Replacing and repairing procedures 			
	4.7 Perform commissioning	<ul style="list-style-type: none"> Electrical load management Commissioning procedures 			
	4.8 Describe the procedure of Complete work related documents	<ul style="list-style-type: none"> Importance of documentation Customer care procedures & techniques 			

	4.9 Explain the purpose of final	<ul style="list-style-type: none"> Importance of quality 		<ul style="list-style-type: none"> Extension board 	
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	quality inspection	handing-over to client		<ul style="list-style-type: none"> • Series board • Phase tester • Ampere meter • AVO meter • Soldering iron 	
	4.10 Clean up and store tools, equipment and material	<ul style="list-style-type: none"> • Waste disposal procedures • Care of tools and equipment 			
	4.11 Identify the types of maintenance	<ul style="list-style-type: none"> • Maintenance requirements 			
	4.12 Distinguish between preventive and corrective maintenance	<ul style="list-style-type: none"> • Maintenance tools • Schedule of maintenances • Replace and damage • Minor and major maintenance 			
	4.13 State the reason for short circuit	<ul style="list-style-type: none"> • Low quality cable • Increases load • Temperature increases • Un-awareness 			
	4.14 Demonstrate the use of mega meter for a range of tests	<ul style="list-style-type: none"> • Operational tests • Open circuit, short circuit, continuity test, earth leakage test • Earthing test 			

Module 3:	Installation and Assembling					
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: <ul style="list-style-type: none"> • Plan and prepare for work • Install machines and appliances • Perform operational test 					
Duration:	Total:	hours	Theory:	hours	Practice:	hours
Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place	
LU-1: Plan and prepare for work	1.1 Identify, obtain and interpret safety and other regulatory requirements	<ul style="list-style-type: none"> • Safety requirements for assembling <ul style="list-style-type: none"> - Specifications - Hazard identification • Safety requirements for installation <ul style="list-style-type: none"> - Specifications - Hazard identification • Purpose of work permit • Earthing requirements 	Total 170Hrs Theory 25 Hrs Practical 145Hrs		Theory Classroom Practical Lab Workshop	
	1.2 Identify correct position and location for installation	<ul style="list-style-type: none"> • Importance of correct position and location • Physical structure • Review layout plan 				
	1.3 Identify and select the tools and equipment for work	<ul style="list-style-type: none"> • Types of tools, equipment and material 				
	1.4 Interpret circuit diagrams	<ul style="list-style-type: none"> • Drawings and symbols • Specifications 				

LU-2: Install machines and appliances	2.1 Confirm assembling and installation specifications	<ul style="list-style-type: none"> • Assembling requirements • Installation requirements 	Total 230Hrs		Theory Classroom
	2.2 Position and configure machine	<ul style="list-style-type: none"> • Importance of correct position and location • Safety precautions 	Theory 40Hrs		Practical Lab
	2.3 Demonstrate procedures for installing components and connecting electrical circuit with port	<ul style="list-style-type: none"> • Procedures for installing components • Types of joints • Types of wiring • Types of cables • Jointing methods • Concept of neutral, phase and earth • Input / Output voltage • Safety precautions • Confirming assembling 	Practical 190 Hrs		Workshop Local industry
	2.4 Carry out operational testing	<ul style="list-style-type: none"> • Testing procedures and equipment 			
	2.5 Demonstrate procedures for final quality inspection	<ul style="list-style-type: none"> • Importance of quality • Completing documents • Customer care procedures and techniques • Waste disposal procedures • Care of tools and equipment 			

LU-3: Perform operational testing	3.1 Demonstrate procedures for testing and adjusting components and/or parts	<ul style="list-style-type: none"> • Procedures for functional testing and adjustments 	Total 165Hrs		Theory Classroom
	3.2 Demonstrate procedures for commissioning a machine	<ul style="list-style-type: none"> • Basic operation of machine • Settings to adjust performance • Permit closing 	Theory 25Hrs		Practical Lab Workshop Local industry
	3.3 Explain operation of product or appliance to customer	<ul style="list-style-type: none"> • Product knowledge • Communication skills 	Practical 140 Hrs		

Module 4:	Testing and Troubleshooting					
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: <ul style="list-style-type: none"> • Demonstrate diagnostic procedures • Remove faults 					
Duration:	Total:	hours	Theory:	hours	Practice:	hours
Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place	
LU-1: Demonstrate diagnostic procedures	1.1 Explain the purpose of visual inspection	<ul style="list-style-type: none"> • Damage identification <ul style="list-style-type: none"> - cracks - shape and structure - broken parts 	Total 270Hrs	Non Consumable <ul style="list-style-type: none"> • Oscilloscope • Multimeter • Earthing meter • Mega meter Consumable <ul style="list-style-type: none"> • Safety Hazards • Serial port • Pliers • Screw drivers • Spanners • Wire cutter • Wire strippers • AC / DC wires • Batteries • Invertors • Hydrometer • Compass • Nuts and bolts 	Theory Classroom	
	1.2 Demonstrate procedure for implementing testing	<ul style="list-style-type: none"> • Process of different tests • Electrical parameters 	Theory 50Hrs		Practical Lab	
	1.3 Interpret test results	<ul style="list-style-type: none"> • Interpretation of drawings and circuit diagrams 	Practical 220Hrs		Workshop	
	1.4 Implement troubleshooting procedures and identify fault	<ul style="list-style-type: none"> • Troubleshooting • Electrical and electronic parameters • Possible faults <ul style="list-style-type: none"> - Winding insulation - Bearing problem - Coupling fault - Rotor/stator fault 			Local industry	

LU-2: Remove faults	2.1 Identify the repair or replace component parts	<ul style="list-style-type: none"> • Interpretation of drawings and circuit diagrams; product knowledge 	Total 125Hrs		Theory Classroom
	2.2 Carry out operational testing	<ul style="list-style-type: none"> • Product knowledge; Testing procedures and equipment 	Theory 25Hrs		Practical Lab Workshop
	2.3 Explain the reason for short circuit and leakage current	<ul style="list-style-type: none"> • Breakage of natural and phase • Short circuits between Phase natural • Insulation break of cable • Temperature effect • Load increases • Low quality cable, material • Un-awareness 	Practical 100 Hrs		Local industry
	2.4 Identify the fault finding techniques	<ul style="list-style-type: none"> • Visual inspection • Technical inspection 			

Module 5:	Apply continuing professional development					
Objective of the Module:	On completion of this module the trainee will be able to demonstrate the following competencies according to industry standards and/or requirements: <ul style="list-style-type: none"> • Identity professional development needs • Develop professional knowledge, skills and attitudes • Maintain professional proficiency 					
Duration:	Total:	15 hours	Theory:	15 hours	Practice:	0 hours
Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials Required	Learning Place	
LU-1: Identity professional development needs	1.1 Discuss professional development needs	<ul style="list-style-type: none"> • Reasons for professional development 	Total 5 Hrs	Non Consumable <ul style="list-style-type: none"> • Multi media • Projector • Dice • Sound system • White Board Consumable <ul style="list-style-type: none"> • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker 	Theory Classroom	
	1.2 Identify professional development programmes	<ul style="list-style-type: none"> • Access to programmes • Career guidance 	Theory 5 Hrs		Practical Lab Workshop Local industry	

LU-2: Develop professional knowledge, skills and attitudes	2.1 Participate in training programmes	<ul style="list-style-type: none"> • Outcomes and relevance of training 	Total 5 Hrs	Non Consumable <ul style="list-style-type: none"> • Multi media • Projector • Dice • Sound system • White Board Consumable <ul style="list-style-type: none"> • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker 	Theory Classroom Practical Lab Workshop Local industry
	2.2 Document training outcome	<ul style="list-style-type: none"> • Report and portfolio writing 	Theory 5 Hrs		
LU-3: Maintain professional proficiency	3.1 Identify and use self-study sources	<ul style="list-style-type: none"> • Research methods • Access to sources 	Total 5 Hrs	Non Consumable <ul style="list-style-type: none"> • Multi media • Projector • Dice • Sound system • White Board Consumable <ul style="list-style-type: none"> • Flip Chart • Writing pad • Lead pencil • High lighter • White board marker 	Theory Classroom Practical Lab
	3.2 Implement self-study plan	<ul style="list-style-type: none"> • Planning your career 	Theory 5 Hrs		

4. Assessment guidance

Competency-based assessment is the process of gathering evidence to confirm the candidate's ability to perform according to specified outcomes articulated in the competency standard(s).

4.1 Types of assessment

a) Sessional assessment

The goal of sessional assessment is to monitor student progress in order to provide constant feedback. This feedback can be used by the trainers to improve their teaching and by learners to improve their learning.

More specifically, sessional assessments help learners to identify their strengths and weaknesses and help trainers to recognise where learners are struggling and address problems immediately.

Examples of sessional assessments include:

- Observations
- Presentations
- Activity sheets
- Project work
- Oral questions

b) Summative (final) assessment

The goal of summative (final) assessment is to evaluate learning progress at the end of a training programme by comparing it against, e.g. set of competency standards.

Examples of summative assessments include:

- Direct observation of work activities
- Final project
- Written questions

4.2 Principles of assessment

When conducting assessment or developing assessment tools, trainers/assessors need to ensure that the following principles of assessment are met:

Validity

- Indicates if the assessment outcome is supported by evidence. The assessment outcome is valid if the assessment methods and materials reflect the critical aspects of evidence required by the competency standards (Competency units, performance criteria, knowledge and understanding).

Reliability

- Indicates the level of consistency and accuracy of the assessment outcomes. The assessment is reliable if the assessment outcome will produce the same result for learners with equal competence at different times or places, regardless of the trainer or assessor conducting the assessment.

Flexibility

- Indicates the opportunity for learners to discuss certain aspects of their assessment with their trainer or assessor, such as scheduling the assessment. All learners should be made aware of the purpose of assessment, the assessment criteria, the methods and tools used, and the context and proposed timing of the assessment well in advance. This can be achieved by drawing up a plan for assessment.

Fair assessment

- Fair assessment does not advantage or disadvantage particular learners because of status, race, beliefs, culture and/or gender. This also means that assessment methods may need to be adjusted for learners with disabilities or cultural differences. An assessment should not place unnecessary demands on learners that may prevent them from demonstrating competence.

4.3 Assessment template – Sessional and Summative assessment

Module Title	Learning Units	Recommended form of assessment	
		Sessional	Summative
Module 1: Electrical Theory	LU-1: Describe basic electrical concepts LU-2: Identify hazards associated with electricity LU-3: Describe sources of electricity generation LU-4: Calculate electrical variables LU-5: Perform measurements in electrical circuits LU-6: Demonstrate knowledge of electric power LU-7: Describe resistive, inductive and capacitive loads LU-8: Describe basic magnetic principles	<ul style="list-style-type: none"> • Activity sheets • Simulation • Oral and written questions 	Integrated assessment: <ul style="list-style-type: none"> • Project • Demonstration • Role play • Oral and written questions
Module 2: Maintenance	LU-1: Plan and prepare for work LU-2: Use tools and equipment LU-3: Inspect and troubleshoot system LU-4: Conduct preventive and corrective maintenance	<ul style="list-style-type: none"> • Observation • Simulation • Oral and written questions • Demonstration 	
Module 3: Installation and Assembling	LU-1: Plan and prepare for work LU-2: Install machines and appliances LU-3: Perform operational testing	<ul style="list-style-type: none"> • Observation • Oral and written questions • Demonstration 	
Module 4: Testing and troubleshooting	LU-1: Demonstrate diagnostic procedure LU-2: Remove Fault	<ul style="list-style-type: none"> • Observation • Simulation • Oral and written questions • Demonstration 	
Module 5: Continuing Professional Development	LU-1: Identify professional development needs LU-2: Develop professional knowledge, skills and attitudes LU-3: Maintain professional proficiency	<ul style="list-style-type: none"> • Activity sheets • Oral and written questions 	

5. List of Tools, Machinery & Equipment

Occupational title		Electrical Equipment Installer & Repairer (Assistant) – Level 2	
Duration		12 months	
Sr. No.	Name of Item/ Equipment / Tools		Quantity
1.	Adjustable wrench		
2.	Amp meter		
3.	AVO meter		
4.	Batteries		
5.	Battery charger		
6.	Bench vice		
7.	Ceiling hole cutter		
8.	Charge controller		
9.	Chisel		
10.	Clamp on meter		
11.	Compass		
12.	Cutter		
13.	Drill machine		
14.	Earth tester meter		
15.	Extension board		
16.	File set		
17.	First Aid box		

18.	Gloves	
19.	Goggles	
20.	Grinder	
21.	Hammer	
22.	Hand drill machine	
23.	Helmet	
24.	Hertz meter	
25.	Hexsaw	
26.	Knife (cable)	
27.	Level	
28.	L-key set	
29.	Lock plier	
30.	Measuring tape	
31.	Megger meter (Analog& Digital)	
32.	Micrometer	
33.	Multimeter	
34.	Number punch	
35.	Phase sequence meter	
36.	Pipe cutter	
37.	Pipe vice	
38.	Pipe wrench	

39.	Plier set	
40.	Punching tool (Networking /Telephone)	
41.	Ratchet set	
42.	Safety boots	
43.	Scissor	
44.	Screw driver set	
45.	Soldering iron	
46.	Spanner set	
47.	Steel scale	
48.	Steel wire	
49.	synchronizing meter	
50.	Techo meter	
51.	Tester	
52.	Thimble press	
53.	Tong tester (clamp on meter) AC/DC	
54.	Torch	
55.	Verniercaliper	
56.	Volt meter	
57.	Wire gauge	
58.	Wood saw	

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