Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

INDUSTRIAL ELECTRICAL EQUIPMENT ASSEMBLING

ELTEA401

ASSEMBLE INDUSTRIAL ELECTRICAL EQUIPMENT

Competence

RQF Level: 4

Learning Hours 70

Credits: 7

Sector: Energy

Trade: Electrical Technology

Module Type: Specific

Curriculum: ENGELT 4001-TVET Level 4 in Electrical Technology

Issued date: May, 2023

Purpose statement	This module describes the skills, Knowledge and attitude required to assemble industrial electrical equipment. Learner will be able to assemble distribution board, rotating machines and static machines. He/she will be able to test assembled equipment and to estimate cost. Qualified learner declared competent to this competency might work under minimum supervision.					
Learning assumed to be in place	Industrial technical drawing, Electromagnetic circuit of electrical machines building.					
Delivery modality	**Training delivery**		**100%**	**Assessment**		**Total 100%**
	Theoretical content		30%	Formative assessment	30%	50%
	Practical work:		70%		70%	
	1. Group work and presentation	30%				
	2. Individual work	40%				
			Summative Assessment			50%

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1. **Perform pre-assembling activities**	1.1. Tools, materials, and equipment are appropriately identified based on the types and use.
	1.2. Personal Protective Equipment (PPE) s are properly used based on safety precautions.
	1.3. Workplace is well prepared according to the workplace preparation policy and procedures.
2. **Perform equipment assembling and disassembling**.	2.1 Power Distribution Board is correctly assembled according to installation steps.
	2.2 Rotating machines are correctly assembled according to the machine construction parts.
	2.3 Static machines are appropriately assembled according to the machine construction parts.

	2.4 Rotating machines are correctly disassembled according to the static machine disassembling procedures.
	2.5 Static machines are correctly disassembled according to the static machine disassembling procedures.
3. **Conduct post-assembling tests and labelling**	3.1. Industrial electrical machines are correctly tested according to the testing technics.
	3.2. Nuts and bolts tightness are correctly tested according to torque measurement technics.
	3.3 Protective devices and wiring systems are appropriately labelled according to the labelling methods.
	3.4 Functionality tests are correctly performed according to the working principles.

Intended Knowledge, Skills and Attitude

Knowledge	Skills	Attitude
✓ Types of tools, materials, and equipment ✓ Electrical attitude ✓ Safety rules, precautions and security ✓ Use of Personal Protective equipment ✓ Technical drawing ✓ Technical symbols ✓ Interpretation of specifications ✓ Quality of materials	✓ Computer skills ✓ Communication skills ✓ Report elaboration skills ✓ Good service delivering skills ✓ Interpersonal skills ✓ Analytical skills ✓ Strong critical thinking skills and excellent problem solving ✓ Task management skills ✓ Diagnostic skills ✓ Accountability	✓ Honest ✓ Self-motivated ✓ Gender sensitive ✓ Customer care oriented ✓ Decisive ✓ Humble ✓ Creative ✓ Patient ✓ Responsible ✓ Innovative ✓ Flexible ✓ integrity ✓ Goal oriented ✓ Self-confident

✓ Mechanical attitude ✓ Applied mathematics	✓ Teamwork ✓ Professionalism ✓ Commitment to continuous learning ✓ Time keeping and organization skills ✓ Inclusiveness ✓ Professionalism ✓ Assembling skills ✓ Measuring skills	

Course content

Learning outcomes	At the end of the module the learner will be able to: 1. Perform pre-assembling activities 2. Perform equipment assembling and disassembling. **3.** Conduct post-assembling tests and labelling
Learning outcome 1: Perform pre-assembling activities	**Learning hours: 10 hours**
Indicative content	

- **Identification of tools, materials and equipment**
  - ✓ Tools based on types and use
  - ✓ Materials based on the type and use
  - ✓ Equipment based on the types and use
- **Use of Personal Protective Equipment (PPE)**
  - ✓ Categories of PPE and their function
  - ✓ Prevention and control of hazards
  - ✓ Accident
    - Causes
    - Types

- Prevention measure

✓ Safety signs and symbols

- Condition signs
- Warning signs
- Prohibition signs
- Instruction signs

- **Workplace preparation**

✓ Workplace preparation policy and procedures

✓ Types of fire extinguishers and their application

✓ Types of workplace ventilation

✓ Workplace cleaning procedures

Resources required for the learning outcome	
Equipment	Multimeter, Wattmeter, Energy meter, Nose Pliers, Line tester, Soldering iron, Motorized coil, winding machine, Hand operated coil winding, Bench work, Coil winding machine, Vise.
Materials	Conductors, Tin Wires, Insulation material (varnish, insulating papers), Laminated sheets (E, I and U forms).
Tools	Neon tester, Screw drivers, Hammers, Coil tamping tools, Mallet, Wire brushes, Wire strippers, slotting files, Connectors, cutting pliers, Crimping tool, Standard wire gauge, machine Bench work, Soldering iron Vernier calliper, Measuring tape, Electromechanical tool kit, Electrician knife, Nose plier, Brushes, Vernier calliper, Books, Internet
Facilitation techniques	▪ Brainstorming ▪ Group discussion ▪ Physical demonstration ▪ Documentary Research
Formative assessment methods /(CAT)	▪ Written assessment ▪ Oral presentation assessment ▪ Performance assessment ▪ Product assessment
Learning outcome 2: Perform equipment assembling and disassembling	**Learning hours: 50 hours**

Indicative content

- **Assemble Power Distribution Board**
  - ✓ Introduction
    - Definition
    - Purpose
    - Application
  - ✓ Main components
  - ✓ Types
  - ✓ Assembling steps
- **Assemble rotating machines**
  - ✓ Introduction
    - Definition
    - Purpose
    - Application
  - ✓ Construction parts
    - Electrical parts
    - Mechanical parts
  - ✓ Assembling procedures
  - ✓ Prepare winding diagram
    - Procedure for development of winding diagram
    - Draw the wiring diagram
    - Interpret the winding scheme
  - ✓ Wind the rotating machine
    - Winding methods (Hand winding, Formed coil winding)
    - Steps for winding/rewinding of rotatingmachines
- **Assemble static machines**
  - ✓ Introduction
    - Definition
    - Purpose
    - Application
  - ✓ Construction parts and accessories
  - ✓ Prepare winding diagram
    - Transformer windings connection diagrams

- Transformer windings termination/labelling

✓ Use laminated sheets

- Construction materials of transformer laminated sheets
- Types of transformer laminated sheets

✓ Wind the coil

- Steps of coils winding

✓ Insulate winding

- Winding insulation techniques

✓ Assemble the machine

- Steps for transformer assembling

✓ Report the work done

- Elaborate the work report (Report format, Cost estimation)

- **Disassemble Rotating machines**

✓ Disassembling of the machine

- Disassembling Procedures

- **Disassemble static machines**

✓ Transformer disassembling process

- Enclosure removing
- Removal of windings
- Removal of core
- Disassemble core materials

Resources required for the learning outcome

Equipment	Multimeter, Wattmeter, Energy meter, Rotating machine, Motorized coil winding machine or Hand operated coil winding machine, Bench work and Tachometer
Materials	Connectors, Standard wiregauge, Coils, Conductors, Rotor, Lamination paper, Tin, Insulation materials, Varnishes
Tools	Books, Internet, Screw drivers, knives, Soldering iron Hammers, Coil tamping tools, Mallet, Wire brushes, Wire strippers, slotting files, Cutting pliers, Crimping tool, Nose Pliers Neon tester (phase tester), Line tester, Manual, Winding diagram, Hand-out notes, Electromechanical tool kit
Facilitation techniques	▪ Brainstorming ▪ Group discussion ▪ Physical demonstration ▪ Practical exercises ▪ Documentary Research
Formative assessment methods /(CAT)	▪ Written evidence ▪ Oral evidence ▪ Performance evidence

	▪ Product evidence
Learning outcome 3: Conduct post-assembling tests and labelling	**Learning hours: 10 hours**

Indicative content

- **Testing technics of industrial electrical machine**
  - ✓ Rotating machine testing
    - General faults in rotating machine (continuity and short-circuit)
    - Test electrical parts of machine
    - Test mechanical parts of machine
    - Test machine characteristic (load and No load)
  - ✓ Transformer faults
    - Insulation breakdown between winding and earth
    - Insulation breakdown in between different phases
    - Insulation breakdown in between adjacent turns i.e., Inter - turn fault
    - Continuity faults
    - Transformer core faults
  - ✓ Transformer tests
    - Winding continuity test
    - Insulation test
    - Transformer characteristic (On-load, No-load / Open circuit, Short-circuit characteristics)
- **Testing of nuts-and-bolts tightness**
  - ✓ Torque measurement technics
- **Labelling of Protective devices and wiring systems**
  - ✓ Labelling methods
    - Heat Shrink Labels
    - Self-Laminating Wire Labels
    - Wire/Cable Tags.
- **Functionality tests performance**
  - ✓ Industrial electrical equipment working principles
    - Rotating machines
    - Static machine

Resources required for the learning outcome	
Equipment	Multimeter, Wattmeter, Energy meter, Nose Pliers, Line tester, Soldering iron, Motorized coil, Winding machine, Hand operated coil winding, Bench work, Coil winding machine, Vise, Transformer, Rotating machine
Materials	Nuts, bolts
Tools	Screw drivers, knives, Hammers, Coil tamping tools, Mallet, Wire brushes, Wire strippers, slotting files, Cutting pliers, Crimping tool, Nose Pliers Neon tester (phase tester), Line tester, Manual, Winding diagram, Hand-out notes, Electromechanical tool kit
Facilitation techniques	▪ Brainstorming ▪ Group discussion ▪ Practical exercises ▪ Documentary Research ▪ Video show
Formative assessment methods /(CAT)	▪ Written evidence ▪ Performance evidence

Integrated/Summative assessment

Integrated situation

Pfunda tea company located at Rubavu district, Rugerero Sector, have three phase AC motor of 11kw, 7kw, 15kw supplied from industrial transform located near the industry. During flood condition water hits transformer and by passing into industry reaches to 11Kw motor operating shaking machine. When flood is over, the chief technician of industry tries to run again the motor but the motor fails to run. He asks one of technician to check if the power is arriving to a motor, they also found that there is no power in the line from a transformer supplying industry. After different assessment of line, he found that a transform is not providing output power, they tried to use another source of supply motor also fails. The chief technician of industry assigns tasks to technician of disassembling these machines and assembling after check the problem. You as one of assistant technician in industry you are hired to perform the tasks with 10 hours.

- Disassemble solve the problem and reassemble of motor
- Disassemble solve the problem and reassemble assembling of transformer

Resources

Tools	Screw drivers, knives, Hammers, Soldering iron, Coil tamping tools, Mallet, Wire brushes, Wire strippers, slotting files, Cutting pliers, Crimping tool, Nose Pliers Neon tester (phase tester), Line tester, Manual, Winding diagram, Hand-out notes, Electromechanical tool kit
Equipment	Multimeter, Wattmeter, Energy meter, Rotating machine, Motorized

	coil winding machine or Hand operated coil winding machine, Bench work, Tachometer, transformer.
Materials/ Consumables	Connectors, Standard wiregauge, Soldering iron, Coils, Conductors, Rotor, Lamination paper, Tin, Insulation materials, Varnishes

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
1. Perform pre-assembling activities	1.1. Tools, materials, and equipment are appropriately identified based on their types and use	Tools are appropriately identified			2
		materials are appropriately identified			2
		equipment are appropriately identified			2
	1.2. Personal Protective Equipment (PPE) s are properly used based on safety precautions	Personal Protective Equipment is properly used			5
	1.3. Working place is appropriately prepared according to the workplace policy and procedures.	Working place is appropriately prepared			4
2. Perform equipment assembling and disassembling.	2.1 Power Distribution Board is correctly assembled according to installation steps.	Power distribution board assembling steps are correctly respected			6
	2.2 Rotating machines are correctly assembled according to the machine construction parts.	Insulating material are correctly inserted in slots			2
		Windings are properly inserted in slots			2
		Windings are separated correctly by busing insulation			2

		Windings terminals are correctly pooled out and fixed in terminal box			3
		Rotor is properly inserted in stator			3
		bearings are appropriately fixed			2
		Ventilator is correctly fixed on rotor shaft			2
		Ventilator case is closed correctly			2
		Stator case is properly fixed on motor support			2
		Nuts and bolts are tightly fixed			2
	2.3 Static machines are appropriately assembled according to the machine construction parts.	Static machine core is correctly assembled with respect to core shapes			2
		Static machine primary and secondary coils are correctly wound on transformer core			2
		Insulation materials is properly put on windings of transformer			2
		Transformer enclosure is correctly closed			2

		Transformer coils terminals are properly pooled out and fixed			2
		Nuts and bolts are tightly fixed			2
	2.4 Rotating machines are correctly disassembled according to the static machine disassembling procedures.	Nuts and bolts are properly removed			2
		Stator case is properly dismantled on motor support			3
		Ventilator case is opened correctly			1
		Ventilator is correctly removed on rotor shaft			1
		bearings are appropriately removed			2
		Rotor is properly pooled out from stator			2
		Windings terminals are correctly realised in terminal box			2
		Insulation is correctly removed from windings			2
		Windings are properly removed form slots			1
		Insulating material are correctly removed from slots			1
	2.5 static machines are correctly disassembled according to the static machine disassembling procedures.	Nuts and bolts are properly removed			2
		Transformer coils terminals are properly removed			2
		Transformer enclosure is correctly opened			1
		Insulation materials is properly removed from windings of transformer			2
		Static machine primary and secondary coils are correctly dismantled from transformer core			3
		Static machine core is			3

		correctly disassembled with respect			
3. Conduct post-assembling tests and labelling	3.1. Industrial electrical machines are correctly tested according to the testing technics	Continuity test is appropriately performed			2
		short-circuit test correctly tested performed			2
	33.2. Nuts and bolts tightness is correctly tested according to torque measurement technics.	Nuts and bolts are correctly tightened with respect to the place			3
		Tightness of nuts is correctly measured			2
	3.3. Protective devices and wiring systems are appropriately labelled according to the labelling methods	Protective devices are appropriately labelled			2
		incoming and outgoing wiring systems are appropriately labelled			2
	3.4 Functionality tests are correctly performed according to the working principles.	Functionality tests is correctly performed			2
Total marks					100
Percentage Weightage					100%
Minimum Passing line % (Aggregate):					70%

List of abbreviations

1. **ISO**: (independent system operator) International Organization for Standardization
2. **TVET**: technical vocation and education training
3. **RQF**: Rwanda Qualification Framework
4. **RTB**: Rwanda TVET Board
5. **PPE**: Person Protective Equipment
6. **CAT**: Continuous Assessment Test
7. **NA**: Not Applicable

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Glossary

Delivery modality: describes various methods or formats in which training programs are delivered to participants

Pre-assembling activities: activities that are conducted or completed before the actual assembling takes place.

Tools: instruments designed to facilitate the process of assembly or disassembly and ensure efficient and safe handling of the parts involved.

Materials: resources that are used to create or construct something. Materials can be physical substances, natural or synthetic, that have specific properties and characteristics. They are often used in manufacturing, construction, and various other industries.
Equipment: devices used specifically for the process of assembling or putting together various components or parts to create a finished product or structure
Workplace: location or environment where work is conducted. It is a place where employees, staff members, or workers engage in their job duties and responsibilities

Safety: include providing training and education to individuals to ensure they understand the risks involved and how to mitigate them. This can involve training programs, safety drills, emergency response procedures, and ongoing education to promote awareness and safe practices.
Post assembling: tasks or actions that are carried out after the completion of the assembly process. These activities are focused on inspecting, testing, and preparing the assembled product or system for its intended use.
Rotating machine: mechanical devices or equipment that generate rotational motion or convert electrical energy into mechanical rotational motion.
Static machines: electrical machines or devices that do not have moving parts or generate mechanical motion. They are used for the efficient transfer of electrical energy **between different voltage levels.** They work based on the principle of electromagnetic induction and consist of two or more coils wound around a magnetic core.
Learning outcome: specific statements that describe what learners are expected to know, understand, or be able to do after completing a learning experience, such as a course, training program, or educational activity.

Module: refers to a self-contained instructional unit or segment within a broader training program or curriculum. It is designed to deliver specific learning content and objectives in a structured and organized manner. A training module typically focuses on a particular topic, skill, or competency and provides learners with the necessary knowledge and guidance to achieve the desired learning outcomes

Brainstorming: a creative problem-solving technique that involves generating a large number of ideas or potential solutions to a specific problem or challenge. It is a group activity that encourages participants to freely express their thoughts and ideas without criticism or judgment. Brainstorming sessions are typically structured to promote open and collaborative thinking, fostering innovation and creativity.

Formative assessment: a type of assessment that is conducted during the learning process to monitor student progress, provides feedback, and informs instructional decisions.

Summative assessment: a type of assessment used to evaluate learning outcomes at the end of a unit or course

Resources: refers to various materials, tools, or assets that are available to individuals or organizations to support or facilitate a particular task, project, or goal