# MINISTRY OF EDUCATION AND SPORTS

## UGANDA BUSINESS AND TECHNICAL EXAMINATIONS BOARD

## MODULAR ASSESSMENT SYLLABUS FOR NATIONAL CERTIFICATE IN ELECTRICAL INSTALLATION SYSTEMS AND MAINTENANCE (NCES)

**FEBRUARY 2022**

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## PROGRAMME OVERVIEW

This Modular Assessment Guide has been prepared to guide training institutions preparing trainees for Uganda Business and Technical Examinations Board (UBTEB) assessment and the industry.

The Syllabus for National Certificate in Electrical Installation Systems and Maintenance has been divided into core modules and support modules to develop the guide. The core modules are flexible to allow free entry and exit of learners to the world of work after attaining employable skills.

Each Core module is independent but emphasising competences and the trainee has a choice to pick which to start with; putting into account the available resources and time they have to complete the training.

At the end of each core module, the trainee who successfully completes the training is given a competence certificate in that particular core module. But those who successfully complete all the modules will be awarded with a National Certificate in Electrical Installation Systems and Maintenance.

## MODULARIZATION OF ASSESSMENT

The modularization of assessment is intended to bring together particular set of skills and competencies that can lead to an occupation of job as a complete package. The completion of such packages by the trainee leads to a certificate of competence in that particular module. It is upon the trainee to continue pursuing training for other packages or to join the world of work for any gainful employment. This will help the trainees to compile their learning achievements and those that may not be able to undertake the entire training can join the world of work and come back later when they need more sets of skills. The trainee will be given a complete certificate on completion of all the packages under that certificate. This will also help in the recognition of prior learning for those who join with some experience into the training.

In addition, the modularization of assessment is meant to integrate other skills like the entrepreneurship, communication, computer skills and work ethics through a typical work process which can lead to production of a holistically trained graduate who can perform to the required standard of the world of work.

## CORE MODULES AND THEIR EXPECTED OUTCOME

| Sn | Module | Expected Outcome | Award |
|---|---|---|---|
| 1) | TCES101-Domestic Electrical Installation, Maintenance and Repair | Install, Maintain and Repair Domestic Electrical Installations | Certificate of Competence in Domestic Electrical Installation, Maintenance and Repair |
| 2) | TCES102-Solar PV Systems Installation, Maintenance and Repair | Install, Maintain and Repair Solar PV Systems | Certificate of Competence in Solar PV Systems Installation, Maintenance and Repair |
| 3) | TCES201-Generators Installation, Maintenance and Repair | Install, Maintain and Repair Generators | Certificate of Competence in Generators Installation, Maintenance and Repair |
| 4) | TCES202-Electrical Motors Installation, Maintenance and Repair | Install, Maintain and Repair Electrical Motors | Certificate of Competence in Electrical Motors Installation, Maintenance and Repair |

## SUPPORT MODULES

| Sn | Module Code | Module Name |
|---|---|---|
| 1) | TCCS 101 | Life Skills |
| 2) | TCCA 101 | Computer Applications |
| 3) | TCTM 101 | Applied Technician Mathematics I |
| 4) | TCTM 201 | Applied Technician Mathematics II |
| 5) | TCBE 201 | Entrepreneurship Skills |
| 6) | TCCS 201 | Basic Kiswahili |

**MODULE STRUCTURE FOR NATIONAL CERTIFICATE IN ELECTRICAL INSTALLATION SYSTEMS AND MAINTENANCE**

| YEAR | Code | Module Title | No. of Weeks | Hours per Week | L | P | CH | CU |
|---|---|---|---|---|---|---|---|---|
| ONE | TCES101 | Domestic Electrical Installation, Maintenance and Repair **Theory** | 15 | 6 | 0 | 90 | 45 | 3 |
| | TCES102 | Domestic Electrical Installation, Maintenance and Repair **Practice** | 15 | 12 | 0 | 180 | 90 | 6 |
| | TCES103 | Domestic Electrical Installation, Maintenance and Repair **Real Life Project** | 15 | 6 | 0 | 90 | 45 | 3 |
| | TCES104 | Solar PV Systems Installation, Maintenance and Repair **Theory** | 15 | 6 | 0 | 90 | 45 | 3 |
| | TCES105 | Solar PV Systems Installation, Maintenance and Repair **Practice** | 15 | 12 | 0 | 180 | 90 | 6 |
| | TCES106 | Solar PV Systems Installation, Maintenance and Repair **Real Life Project** | 15 | 6 | 0 | 90 | 45 | 3 |
| | TCES107 | Industrial Training I | 6 | 40 | 0 | 240 | 30 | 2 |
| | TCCS101 | Life Skills | 30 | 2 | 60 | 0 | 60 | 4 |
| | TCCA101 | Computer Applications | 30 | 2 | 60 | 0 | 60 | 4 |
| | TCTM101 | Applied Technician Mathematics I | 30 | 2 | 60 | 0 | 60 | 4 |
| TWO | TCES201 | Generators Installation, Maintenance and Repair **Theory** | 15 | 6 | 0 | 90 | 45 | 3 |
| | TCES202 | Generators Installation, Maintenance and Repair **Practice** | 15 | 12 | 0 | 180 | 90 | 6 |

| YEAR | Code | Module Title | No. of Weeks | Hours per Week | L | P | CH | CU |
|---|---|---|---|---|---|---|---|---|
| | TCES203 | Generators Installation, Maintenance and Repair **Real Life Project** | 15 | 6 | 0 | 90 | 45 | 3 |
| | TCES204 | Electrical Motors Installation, Maintenance and Repair **Theory** | 15 | 6 | 0 | 90 | 45 | 3 |
| | TCES205 | Electrical Motors Installation, Maintenance and Repair **Practice** | 15 | 12 | 0 | 180 | 90 | 6 |
| | TCES206 | Electrical Motors Installation, Maintenance and Repair **Real Life Project** | 15 | 6 | 0 | 90 | 45 | 3 |
| | TCES207 | Industrial Training II | 6 | 40 | 0 | 240 | 30 | 2 |
| | TCTM201 | Applied Technician Mathematics II | 30 | 2 | 60 | 0 | 60 | 4 |
| | TCBE201 | Entrepreneurship Skills | 30 | 2 | 60 | 0 | 60 | 4 |
| | TCCS201 | Basic Kiswahili | 30 | 2 | 60 | 0 | 60 | 4 |
| | Total | | | | | | 1140 | 76 |

**YEAR ONE NCES FINAL ASSESSMENT PAPER FORMAT**

| Paper code & Name | Examination format |
|---|---|
| 1) TCES102 Domestic Electrical Installation, Maintenance and Repair Practice<br>2) TCES105 Solar PV Systems Installation, Maintenance and Repair Practice | Each paper shall consist of one compulsory practical question carrying 100marks and it shall be marked on spot<br>UBTEB will send an external assessor to assess the trainees as they progress with the examinations.<br>The questioning techniques to be applied should seek the trainee's ability to demonstrate and apply the practical skills acquired during the training.<br>UBTEB will send to the institutions the cutting list of the items needed for practical two weeks for preparation before the examinations date<br>The total duration of the examination shall be 6Hours. |
| 3) TCES101 Domestic Electrical Installation, Maintenance and Repair Theory<br>4) TCES104 Solar PV Systems Installation, Maintenance and Repair Theory<br>5) TCCS101 Life Skills<br>6) TCTM101 Applied Technician Mathematics I | Each paper shall consist of eight questions, each carrying 20 marks and the trainee shall answer five questions.<br>The questioning techniques to be applied should seek for the trainee's ability to comprehend, apply, analyse, synthesize and evaluate conditions<br>The total duration of the examination shall be 3Hours. |
| 7) TCCA 101: Computer Applications | The paper shall consist of one practical section with only three questions carrying 50 marks each. A candidate will be required to answer any two questions. A print out of the practical outputs together with the soft copies of all files used will be sent to the assessing body.<br>The duration of this practical examination shall be two hours. |
| 8) TCES102 Domestic Electrical Installation, | The paper shall consist of continuous assessment marks. UBTEB shall verify the authenticity of the |

| Paper code & Name | Examination format |
|---|---|
| Maintenance and Repair Practice<br>9) Maintenance and Repair Real Life Project<br>10)TCES106 Solar PV Systems Installation, Maintenance and Repair Real Life Project | awarded marks from the completed projects on the ground and trainee's participation through presentations.<br>The tasks to be performed should seek for leaners' ability to comprehend, apply, analyse, synthesize and evaluate conditions.<br>The trainees are expected to:<br>• Prepare and interpret drawings.<br>• Plan execution of the job.<br>• Prepare bills of quantities<br>• Carry out actual installation, maintenance and repair<br>• Carry out the work in according to IEE regulations.<br>The total duration of the examination shall be 90 practical hours. |
| 11)TCES107 Industrial Training I | Industrial Training shall be assessed out of 100 marks and will be carried out at the end of year one<br>The module will be assessed as shown below:<br>Requirements — Contribution<br>Attendance — 10%<br>Work performance involvement — 25%<br>Initiative and innovation — 10%<br>Time management — 10%<br>Discipline and safety — 10%<br>Practical skills — 20%<br>Written report — 15%<br>Total — 100%<br>The total duration of the industrial training shall be six (6) weeks |

**YEAR TWO NCES FINAL ASSESSMENT PAPER FORMAT**

| Paper code & Name | Examination format |
|---|---|
| 1) TCES202 Generators Installation, Maintenance and Repair Practice<br>2) TCES205 Electrical Motors Installation, Maintenance and Repair Practice | Each paper shall consist of one compulsory practical question carrying 100marks and it shall be marked on spot<br>UBTEB will send an external assessor to assess the trainees as they progress with the examinations.<br>The questioning techniques to be applied should seek the trainee's ability to demonstrate and apply the practical skills acquired during the training.<br>UBTEB will send to the institutions the cutting list of the items needed for practical two weeks for preparation before the examinations date<br>The total duration of the examination shall be 6Hours. |
| 3) TCES201 Generators Installation, Maintenance and Repair Theory<br>4) TCES204 Electrical Motors Installation, Maintenance and Repair Theory<br>5) TCBE201 Entrepreneurship Skills<br>6) TCTM201 Applied Technician Mathematics II | Each paper shall consist of eight questions, each carrying 20 marks and the trainee shall answer five questions.<br>The questioning techniques to be applied should seek for the trainee's ability to comprehend, apply, analyse, synthesize and evaluate conditions<br>The total duration of the examination shall be 3Hours. |
| 7) TCCS201 Basic Kiswahili | The paper shall consist of two sections; Section A (general Kiswahili) and Section B (professional). Section A shall consist of five questions and a candidate will be required to answer any three. Section B shall consist of three questions and a candidate shall be |
| 8) TCES203 Generators Installation, Maintenance and Repair Real Life Project | The paper shall consist of continuous assessment marks. UBTEB shall verify the authenticity of the awarded marks from the completed projects on the |

<table>
<tr><th>Paper code & Name</th><th>Examination format</th></tr>
<tr><td>9) TCES206 Electrical Motors Installation, Maintenance and Repair Real Life Project</td><td>ground and trainee's participation through presentations.<br>The tasks to be performed should seek for leaners' ability to comprehend, apply, analyse, synthesize and evaluate conditions.<br>The trainees are expected to:<br>• Prepare and interpret drawings.<br>• Plan execution of the job.<br>• Prepare bills of quantities<br>• Carry out actual installation, maintenance and repair<br>• Carry out the work in according to IEE regulations.<br>The total duration of the examination shall be 90 practical hours.</td></tr>
<tr><td>10)TCES207 Industrial Training II</td><td>Industrial Training shall be assessed out of 100 marks and will be carried out at the end of year two<br>The module will be assessed as shown below:<br>Requirements — Contribution<br>Attendance — 10%<br>Work performance involvement — 25%<br>Initiative and innovation — 10%<br>Time management — 10%<br>Discipline and safety — 10%<br>Practical skills — 20%<br>Written report — 15%<br>Total — 100%<br>The total duration of the industrial training shall be six (6) weeks</td></tr>
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**ASSESSMENT PLAN FOR NCES**

| Semester | Assessments | Assessment Components |
|---|---|---|
| Year I semester I | 1) TCES101 Domestic Electrical Installation, Maintenance and Repair Theory | Coursework and Final Assessment |
| | 2) CES102 Domestic Electrical Installation, Maintenance and Repair Practice | Coursework and Final Assessment |
| | 3) TCES102 Domestic Electrical Installation, Maintenance and Repair Real Life Project | Coursework, Report and PowerPoint presentation |
| Year I semester II | 1) TCES104 Solar PV Systems Installation, Maintenance and Repair Theory | Coursework and Final Assessment |
| | 2) CES105 Solar PV Systems Installation, Maintenance and Repair Practice | Coursework and Final Assessment |
| | 3) TCES106 Solar PV Systems Installation, Maintenance and Repair Real Life Project | Coursework, Report and PowerPoint presentation |
| | 4) TCCS101 Life Skills | Coursework and Final Assessment |
| | 5) TCCA 101 Computer Applications | Coursework and Final Assessment |
| | 6) TCTM101 Applied Technician Mathematics I | Coursework and Final Assessment |
| | 7) TCES107 Industrial Training I | Coursework and Report |
| Year II semester I | 1) TCES201 Generators Installation, Maintenance and Repair Theory | Coursework and Final Assessment |
| | 2) TCES202 Generators Installation, Maintenance and Repair Practice | Coursework and Final Assessment |
| | 3) TCES203 Generators Installation, Maintenance and Repair Real Life Project | Coursework, Report and PowerPoint presentation |
| Year II semester II | 1) TCES204 Electrical Motors Installation, Maintenance and Repair Theory | Coursework and Final Assessment |
| | 2) TCES205 Electrical Motors Installation, Maintenance and Repair Practice | Coursework and Final Assessment |
| | 3) TCES206 Electrical Motors Installation, Maintenance and Repair Real Life Project | Coursework, Report and PowerPoint presentation |

| | | |
|---|---|---|
| | 4) TCBE201 Entrepreneurship Skills | Coursework and Final Assessment |
| | 5) TCCS201 Basic Kiswahili | Coursework and Final Assessment |
| | 6) TCTM201 Applied Technician Mathematics II | Coursework and Final Assessment |
| | 7) TCES207 Industrial Training II | Coursework and Report |

**CORE MODULES DETAILS**

CORE MODULE NAME: DOMESTIC ELECTRICAL INSTALLATION, MAINTENANCE AND REPAIR

Training Outcome: By the end of this module, the trainee should be able to install, maintain and repair domestic electrical installations.

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| 1) Promote health and safety practices. | Prevent Common Workplace Hazards | - Prevent use of Faulty electrical equipment<br>- Prevent Slippery or wet floor<br>- Take precaution of Falling objects or working at a height with ladder<br>- Prevent Poor lighting<br>- Take precautions when working near Chemicals; cleaning agents, pesticides, acid<br>- Take precaution when working near Machinery with moving parts<br>- Take precaution in places of Excessive noise | - Ohms Law<br>o Current, voltage and resistance<br>o Factors affecting resistance of a conductor:<br>o Temperature coefficient of materials<br>o Resistivity, cross sectional area, length<br>- Direct Current Circuits<br>o Series, parallel and series-parallel circuits<br>o Kirchhoff's circuit laws<br>o Cells and batteries<br>o Ring and radial D.C supply | 10 Hours |
| | Rescue Vitim of electric shock | - Isolate supply immediately<br>- Physically removes victim using non-conducting implements.<br>- Check for pulse / breathing | | 10 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Give artificial respiration if necessary.<br>- Contact doctor | ○ Power, energy and kilowatt hour<br>- Workshop/Site Safety and Regulations<br>○ Workshop hazards: fire, electric shock, accidents<br>○ First aid on treating an electric shock casualty<br>○ Safety wears like helmet, goggles, overalls, boots, gloves,<br>○ safety posters<br>- Basic Tools and Equipment<br>○ Identification and correct application of tools<br>○ Care and maintenance<br>○ electrical installation | |
| | Work on Electrical Equipment | - Always isolate supply.<br>- Lock off where possible to prevent unintended switching<br>- Always test conductors in a reliable way before touching. | | 10 Hours |
| | Stop fire | - Identify classes of fires<br>- Select fire extinguishers<br>- Operate fire extinguishers | | 10 Hours |
| 2) Prepare bill of quantities | Draw wiring lay out diagram | - Visit the site<br>- Take measurements<br>- Sketch ground plan<br>- Draw lay out diagram | | 10 Hours |
| | Carry out cable size calculation | - Identify cable type.<br>- Identify correction factors<br>- Determine the size of the load cable<br>- Determine the size of the main breaker | | 20 Hours |
| | Estimate quantity of materials | - Quote local market prices of electrical materials<br>- Determine Total number of sockets, lighting points, | | 20 Hours |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | switches, water heater, cookers, etc<br>- Determine Total length of load cable, cooker cables, water heater cable, sockets and lighting cables<br>- Determine Number of distribution boards<br>- Determine Earthing materials<br>- Determine Labour cost<br>- Determine amount of electrical materials<br>- Determine grand total | systems and maintenance<br>○ Identification and correct application of measuring instruments<br>- Cables and Conductors<br>○ Definition of cable<br>○ Conductor materials used in cables<br>○ Insulating materials<br>○ Types of cables<br>○ Types of cable joints and terminations<br>- Wiring System<br>○ PVC-SWA, PILC, MIMS, PVC conduits<br>○ Trunking system<br>○ Metal conduits, trunking, cable trays<br>○ Ducting systems, bus-bars | |
| 3) Carryout domestic installation | Install conduits and MK boxes | - Survey site<br>- Select tools and materials<br>- Select conduit system components.<br>- Take measurements<br>- Mark wall<br>- Chess wall<br>- Lay conduits<br>- Fix moulded and join boxes | | 20 Hours |
| | Install lighting system | - Determine the number of lighting points<br>- Select switching arrangement.<br>- Select materials and tools<br>- Draw in cables | | 20 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Make cable joints<br>- Install lighting accessories<br>- Carry out termination<br>- Test lighting circuits. | ○ Factors affecting the choice of wiring system (ambient temperature, moisture, corrosion, mechanical damage, damage by animals, ultra violet rays)<br>○ Regulation requirements for each of the above wiring systems<br>- Control and Protection s<br>○ Main switch gears (for isolation and switching): isolators, switch fuses, fuse switches, circuit breakers, change over switches, distribution board/switch board, overload relay, contactors | |
| | Install socket outlet circuits | - Determine the number of ring circuits<br>- Determine the number of radial circuits<br>- Select materials and tools<br>- Draw in cables<br>- Install socket outlets<br>- Test socket outlet circuits | | 20 Hours |
| | Install consumer unit | - Select over current protective devices.<br>- Size over current protective device<br>- Test over current protective device<br>- Install over current protective device<br>- Install main switch<br>- Install RCD and surge arrestors<br>- Install load cable | | 20 Hours |
| | Install water heaters and cookers | - Select tools and materials<br>- Draw in cables<br>- Install cooker control unit<br>- Install water heater indicator switch<br>- Install cooker connecter | | 10 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Carry out termination<br>- Carry out functionality test | ○ Protective devices: re-wireable fuses to BS 3036, cartridge fuses to BS 1361 and 1362, high breaking capacity fuses to BS 88, miniature circuit breakers to BS 3871<br>○ IEE regulations for the above control and protective devices<br>- Consumer's Installation<br>○ Supply sequence<br>○ Consumer unit<br>○ Lighting circuits (one way, two way and intermediate switching)<br>○ Power circuits (radial and ring circuits)<br>○ Water heater circuits | |
| | Install bell and alarm circuits | - Identify bell relay<br>- Select bell type.<br>- Select indicator type.<br>- Install single stroke bell<br>- Install continuous ring bell.<br>- Install trembler bell<br>- Install bell indication system.<br>- Install fire alarm system<br>- Install burglar alarm system | | 10 Hours |
| | Install earthing system | - Select site<br>- Take measurements<br>- Excavate earthing pit<br>- Select materials and tools.<br>- Install earth electrode<br>- Install earthing conductor<br>- Test earth electrode resistance.<br>- Improve earth electrode conductivity | | 10 Hours |
| | Install lightning | - Select site<br>- Take measurements<br>- Excavate grounding pit | | 10 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | protection system | - Install grounding rod<br>- Lay the grounding cable<br>- Install mounting base on the highest point of the roof<br>- Fix lighting rod on the mounting base<br>- Connect grounding cable to the lighting rod and ground rod<br>- Test ground rod resistance.<br>- Improves ground rod conductivity | ○ Cooker circuits<br>○ Installation of bell circuits (types of bells, bell indicators, bell relays, bell supplies, bell and call systems and segregation of circuits)<br>○ Alarm circuits (fire and burglar alarm system)<br>○ IEE regulations for the above circuits<br>- Illumination<br>○ Concept of illumination and basic terms<br>○ Inverse-square law<br>○ Cosine law<br>○ Methods of lighting calculations<br>- Earthing<br>○ Definition of earthing terms (earth, earth | |
| 4) Test domestic electrical installation. | - Carry out circuit protective conductor continuity test<br>- Carry out ring final circuit continuity test<br>- Carry out insulation resistance test | - Select instruments<br>- Record the purpose of the test<br>- Take safety precautions<br>- Record the expected results<br>- Connects the meter<br>- Record the actual results<br>- Rectify faults | | 20 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | - Carry out polarity test<br>- Carry out earth fault loop impedance test<br>- Cary out functional test | | electrode, earth electrode resistance, main earth terminal, earth lead, circuit protective conductor (CPC), extraneous metal work bonding)<br>○ Purpose of earthing<br>○ Earthing system<br>○ Types of earthing (neutral and equipment earthing)<br>○ Earth loop impedance<br>○ Factors influencing earth resistance of electrodes<br>○ preparation of the pit, termination of the electrode)<br>○ Testing earth electrode resistance | |
| | - | - | | |
| 5) Maintain and repair domestic electrical installation | - Carry out Maintenance | - Clean conductors, terminals, and connectors of all corrosion.<br>- Tighten terminals and connectors including breaker<br>- Check the equipment grounding system, including conduit end bushing connections<br>- Check the grounding electrode, grounding electrode conductor, and associated connections. | | 20 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Check conductor insulation for damage, and repair if necessary.<br>- Replace deteriorated cables, equipment and accessories | ○ Process of earthing (selection)<br>- Protection against Lightning<br>○ Factors to determine whether lightning protection is required<br>○ Components of a protection system<br>○ Zone of protection<br>○ Installation of lightning protection<br>○ Corrosion precautions<br>- Inspection and Testing<br>○ Visual inspection (broken components, sizes of components, quality of equipment)<br>○ Continuity tests carried out before supply | |
| | - Rectify Open Circuit Faults<br>- Rectify Short-Circuit Faults<br>- Rectify Overload Fault<br>- Rectify Earth Faults | - Locate the faulty part<br>- Determines the cause of the fault<br>- Rectify the fault | | 20 Hours |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | | connection, CPC and bonding conductors, ring circuits, polarity, insulation resistance<br>○ Earth electrode resistance<br>○ Test with supply connected (polarity with a test lamp, earth fault loop impedance, operation of residual current device)<br>- Cable Size Calculation/Selection<br>○ Application of diversity factor<br>○ Procedure for selecting cable size<br>○ Factors considered when selecting cable size<br>○ Installation methods of cables | |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | | ○ Current carrying capacity of conductors as tabulated in IEE regulations<br>- Lighting Systems<br>○ Filament lamps<br>○ Discharge lamps: (fluorescent, high pressure, mercury vapour, sodium vapour and tungsten halogen lamps)<br>○ Regulations regarding discharge lamps<br>○ Stroboscopic effect<br>○ Operation of fluorescent fitting on DC supply | |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| Assessment<br>The module will be assessed through practical work, assignments, tests and final assessment. Their relative contribution to the final grade is as below:<br>Requirements — Contribution<br>Assignments — 5%<br>Tests — 10%<br>Practical work — 25%<br>Final assessment — 60%<br>Total — 100% | | | | |

CORE MODULE NAME: SOLAR PV SYSTEMS INSTALLATION, MAINTENANCE AND REPAIR

Training Outcome: By the end of this module, the trainee should be able to install, maintain and repair solar PV systems.

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| 6) Promote health and safety practices. | Promote safety | - Wear PPE<br>- Co-operate with other workers<br>- Follow rules and procedures of work<br>- Focus on the work | - Solar PV Technology<br>○ Applications of solar PV technology<br>○ Advantages of solar PV technology<br>○ Limitations of solar PV technology<br>○ Solar cells and modules<br>- Solar Radiation<br>○ Weather and metrological data<br>○ Application of insolation data in photo voltaic system<br>- Components of a Solar PV System<br>○ Solar modules<br>○ Solar batteries<br>○ Charge controllers<br>○ Inverters | 10 Hours |
| | Carry out tasks safely | - Assess the task<br>- Identify the hazards<br>- Define safe systems<br>- Implement the systems | | 10 Hours |
| | Work at a height | - Do as much work as possible from the ground<br>- Prevent falls by using the right type of equipment<br>- Use work equipment to minimize the distance and consequences of a fall<br>- Maintain and check equipment regularly<br>- Doesn't overload or overreach when working at height<br>- Provide protection from falling objects | | 10 Hours |
| 7) Prepare BOQ | Draw wiring | - Visit the site<br>- Take measurements | | 10 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | lay out diagram | - Sketch ground plan<br>- Draw lay out diagram | ○ Power conditioning units<br>- Solar PV System Sizing<br>○ Site planning<br>○ Determination of solar radiation of a locality<br>○ Load energy consumption analysis<br>- PV Installation<br>○ Preparation (planning and transport)<br>○ Good installation practice (wiring, switches, sockets, circuit breakers)<br>○ Light fixtures<br>○ Appliances<br>○ Methods of mounting solar modules<br>- Maintenance of a PV System<br>○ Testing/troubleshooting PV | |
| | Estimation of quantity of materials | - Quote local market prices of electrical materials<br>- Determine the number and specifications of Solar modules, charge controllers, batteries and inverters<br>- Determine Total number of sockets, lighting points, switches, etc<br>- Determine Total length of load cable, sockets and lighting cables<br>- Determine Number of distribution boards<br>- Determine Earthing materials<br>- Determines Labour cost<br>- Determine amount of electrical materials<br>- Determine grand total | | 20 Hours |
| 8) Install Solar PV systems | Install conduits and MK boxes | - Select tools and materials.<br>- Take measurements<br>- Mark wall<br>- Chess wall<br>- Lay conduits<br>- Fix moulded and join boxes | | 20 Hours |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | Install lighting system | - Determines the number of lighting points<br>- Select switching arrangement.<br>- Select materials and tools<br>- Draw in cables<br>- Install lighting accessories<br>- Carries out termination<br>- Test lighting circuits. | ○ Routine maintenance<br>- Solar Thermal Energy<br>○ Solar cookers<br>○ Solar water heaters<br>○ Solar dryers | 20 Hours |
| | Install socket outlet circuits | - Determines the number of ring circuits<br>- Determines the number of radial circuits<br>- Select materials and tools<br>- Draw in cables<br>- Install socket outlets<br>- Test socket outlet circuits | | 16 Hours |
| | Install consumer unit | - select over current protective devices.<br>- Size over current protective device<br>- Test over current protective device<br>- Install over current protective device<br>- Install main switch<br>- Install RCD and surge arrestors<br>- Install load cable | | 10 Hours |
| | Install solar PV | - Install Solar modules,<br>- Install charge controllers | | 20 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | components | - Install batteries<br>- Install inverters | | |
| | Install earthing system | - Select site<br>- Take measurements<br>- Excavate earthing pit<br>- Select materials and tools.<br>- Install earth electrode<br>- Install earthing conductor<br>- Test earth electrode resistance.<br>- Improves earth electrode conductivity | | 10 Hours |
| 9) Test electrical installation. | - Carry out circuit protective conductor continuity test<br>- Carry out ring final circuit continuity test | - Select instruments<br>- Record the purpose of the test<br>- Take safety precautions<br>- Record the expected results<br>- Connects the meter<br>- Record the actual results<br>- Rectify faults | | 20 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | - Carry out insulation resistance test<br>- Carry out polarity test<br>- Carry out earth fault loop impedance test<br>- Cary out functional test | | | |
| 10)Maintain electrical installation | Carry out Maintenance | - Clean conductors, terminals, and connectors of all corrosion.<br>- Tighten terminals and connectors including breaker | | 20 Hours |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Check the equipment grounding system, including conduit end bushing connections<br>- Check the grounding electrode, grounding electrode conductor, and associated connections.<br>- Check conductor insulation for damage, and repair if necessary.<br>- Replace deteriorated cables, equipment and accessories | | |

Assessment

The module will be assessed through practical work, assignments, tests and final assessment. Their relative contribution to the final grade is as below:

| Requirements | Contribution |
|---|---|
| Assignments | 5% |
| Tests | 10% |
| Practical work | 25% |
| Final assessment | 60% |
| Total | 100% |

CORE MODULE NAME: GENERATORS INSTALLATION, MAINTENANCE AND REPAIR

Training Outcome: By the end of this module, the trainee should be able to install, maintain and repair generators.

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| 1) Promote health and safety practices. | Promote work place safety | - Wear PPE<br>- Follow rules and procedures of work<br>- Prevent use of Faulty electrical equipment<br>- Take precaution when working near Machinery with moving parts<br>- Take precaution in places of Excessive noise<br>- Follow the safety and maintenance guidelines in the operator manual<br>- Operate generator outdoors in an area with plenty of ventilation.<br>- Use heavy-duty extension cords to connect appliances to the outlets on the generator.<br>- Turn the generator on before plugging appliances to it. | - Alternating Current<br>o Introduction (alternating quantities current and voltage)<br>o AC values (RMs, average, peak values form factor, peak factor)<br>o Power in single phase AC circuits<br>o Power factor and power factor improvement<br>- Single Phase AC Circuits<br>o Purely resistive, purely capacitive and purely | 10 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Turned off the generator and cool it before fuelling it.<br>- keep the generator dry and do not use in rain or wet conditions<br>- Doesn't power the house wiring by plugging the generator into a wall outlet. Known as "back feeding," this practice puts utility workers, neighbours and household at risk of electrocution<br>- Test the batteries frequently and replace when needed<br>- | inductive AC circuits<br>○ Series, parallel and series-parallel circuits, resonance, q-factor, selectivity<br>- Three Phase AC Circuits<br>○ Generation of three phase supply<br>○ Star connection<br>○ Delta connection<br>○ Power in three phase system<br>○ Balanced and unbalanced loads<br>- Measuring Instruments<br>○ Moving coil instruments<br>○ Moving iron instruments | |
| 2) Prepare bill of quantities | Draw wiring lay out diagram | - Visit the site<br>- Take measurements<br>- Sketch ground plan<br>- Draw lay out diagram | | 10 Hours |
| | Estimate quantity and costs of materials | - Quote local market prices of electrical materials<br>- Determine Total Load capacity | | 20 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Determine Total length of load cable.<br>- Determine Number of distribution boards<br>- Determine Earthing materials<br>- Determine the cost of electrical materials<br>- Determine Labour cost<br>- Determine grand total | ○ Increasing the range of measuring instruments<br>○ Multi meters<br>○ Watt meters<br>○ Measuring electrical quantities<br>○ Energy meters | |
| 1) Install single phase generator | Install generator | - Select site<br>- Select materials and tools<br>- Prepare the foundation<br>- Place the generator on the centre of the foundation<br>- Earth the generator<br>- Install load cable<br>- Install ATS panel<br>- Test run generator | | 20 Hours |
| | Earth generator | - Select site<br>- Select materials and tools.<br>- Prepare two earthing pits, one for body earthing and another for neutral earthing | | 10 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Take measurements<br>- Excavate grounding pits<br>- Install earth electrodes<br>- Install earthing conductors<br>- Never connects the body and neutral earth together<br>- Test earth electrode resistance.<br>- Improves earth electrode conductivity | | |
| 2) Maintain generator | Inspect generator | - Check AVR connection<br>- Check the radiator for free flow of air<br>- Check fluid levels<br>- Check for abnormal noise<br>- Check the working of all meters, lamps and indicators | | 20 Hours |
| | Service generator | - Plug<br>o Remove the plug and wash it with fuel<br>o Scrab the carbon deposit at the tip | | 30 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | ○ Rinse it in fuel and keep it to dry<br>- Duster/Air cleaner<br>○ Remove the duster<br>○ Wash the duster in fuel<br>○ Squeeze out the and keep it to dry<br>- Carburetor<br>○ Remove carburetor<br>○ Wash it with fuel carefully<br>○ Don’t change the arrangement of items in the carburetor<br>○ Allow it to dry for a while before coupling<br>- Replace oil and filter<br>○ Remove the old oil filter<br>○ Inspect the filter housing<br>○ Clean filter housing<br>○ Fill new filter with oil | | |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | ○ Coat new seal with oil<br>○ Install new filter<br>- Clean fuel filter<br>○ Relieve the fuel system's pressure<br>○ Disconnect the battery<br>○ Remove the filter from the fuel lines<br>○ Spray it with a solvent cleaner<br>○ Let it dry for an hour<br>○ Reinstall it<br>○ Reconnect the battery<br>○ Run the engine<br>- Clean air filter<br>○ Locate the air cleaner assembly<br>○ Unlock the clips on the air cleaner cover<br>○ Carefully remove the filter foam<br>○ Wash the filter with detergent and water | | |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | ○ Squeeze and dry it with the clean cloth<br>○ Saturate one side of the filter in a clean layer of clean engine oil<br>○ Remove all excess oil with a clean absorbing cloth<br>○ Place the new or clean filter into the air cleaner housing with the oil side facing the air cleaner assembly<br>○ Replace the air cleaner cover and fastened the clips securely<br>- Fix all the items back<br>○ Starting with the plug,<br>○ Follow by the carburetor<br>○ Followed by the duster<br>○ And lastly the engine oil. | | |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | ○ If the engine oil is dirty or black change it<br>○ If it drops and not black, top it up | | |
| 3) Troubleshoot generator | Troubleshoot generator that runs but has no power output | - Test the resistance of the stator through the outlets<br>○ Record the expected reading<br>○ Turn on the circuit breaker<br>○ Test the resistance through each leg<br>○ Record the actual readings<br>- Check for burnt-out stator windings<br>○ Remove the stator cover<br>○ Check for any broken rope on the stator windings as evidence of over heating<br>○ Check the colour of the wire, black colour as | | 30 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | evidence of burnt-out windings<br>○ Test the resistance of each coil to ground<br>- Test the resistance of the rotor, brushes and slip rings<br>○ Remove the AVR and Brushes<br>○ Record the expected readings<br>○ Test the resistance through the brushes<br>○ Test the resistance on the slip rings<br>○ Test the resistance of each coil/brush to ground<br>○ Record the actual readings<br>- Test the AVR<br>○ Un-plug the AVR<br>○ Hook up 12V on the brushes and check the output | | |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | voltage on the stator<br>○ Record the expected voltage on the stator<br>○ Record actual voltage on the stator<br>○ Plug in the AVR and check the output voltage on the stator<br>○ Test the cable supplying power to AVR<br>○ Replace AVR<br>- Check the brushes and slip rings for proper power transfer<br>○ Pull out the brushes<br>○ Check for worn out brushes<br>○ Get the resistance reading direct from the slip rings<br>○ Clean the slip rings<br>○ Replace brushes | | |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Restore lost residual magnetism<br>o Select 12V battery<br>o Select connection wire<br>o Open stator cover<br>o Supply the 12V to the stator<br>- Check for burnt-out rotor windings<br>o Disassemble the generator<br>o Check the colour of the wire, black colour as evidence of burnt-out windings<br>o Take the measurements of the rotor<br>o Replace the rotor<br>o Assemble the generator | | |
| | Troubleshoot a generator that does not start | - Visually Check the gas level in the tank pipe, should not be less than ¾<br>- Check the oil level<br>- Low oil senser shuts down the engine | | 20 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Check the fuel valve is opening<br>- Choke to start the engine<br>- Turn the ignition switch on<br>- Check the air filter for blockage<br>- Check whether the choke works<br>- Remove the gas line off to see whether the gas valve gets gas through it and drain in to appropriate container<br>- Replace flex line with a transparent tube to see whether the gas flow is good<br>- If there is no gas then the valve is closed<br>- Reconnect gas line<br>- Remove air filter housing see the carburettor easily<br>- Keep rubber gasket and brass bushings<br>- Remove the gas line from the carburettor | | |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Remove throttle assemble<br>- Remove the carburettor<br>- Leave gasket on the carburettor<br>- Open the screw at the bottom<br>- Check for dirt and debris in carburettor jet<br>- Check rubber seal<br>- Blow it out with compressed air<br>- Reassemble the carburettor<br>- Reassemble the generator<br>- Restart the generator | | |

Assessment

The module will be assessed through practical work, assignments, tests and final assessment. Their relative contribution to the final grade is as below:

| Requirements | Contribution |
|---|---|
| Assignments | 5% |
| Tests | 10% |
| Practical work | 25% |
| Final assessment | 60% |
| Total | 100% |

CORE MODULE NAME: ELECTRICAL MOTORS NSTALLATION, MAINTENANCE AND REPAIR

Training Outcome: By the end of this module, the trainee should be able to install, maintain and repair electrical motors.

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| 1) Promote health and safety practices | Promote safety during motor installation | - Ensure that motors are installed, protected and fused in accordance with IEE Regulations<br>- Use Eyebolts or lifting lugs for lifting the motor only.<br>- Ensure that the eyebolt is fully threaded and tight in its mounting hole.<br>- Ensure that Frames and accessories of motors are grounded in accordance with IEE Regulations<br>- Ensure that Rotating parts such as pulleys, couplings, external fans, and shaft extensions are permanently guarded.<br>- Use the proper size of line current protection and motor controls as required by IEE Regulations | - Magnetism<br>o Laws of magnets<br>o Permanent magnets, electromagnets<br>o Method of magnetisation and demagnetisation<br>o Application of magnets<br>o Magnetic circuits<br>o Electromagnetism<br>o Principles and laws of electromagnetism<br>o Force on current carrying conductors<br>o Inductors, mutual inductance and self-inductance | 10 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Disconnect power before working on motor or driven equipment.<br>- Does not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.<br>- Discharge all capacitors before servicing motor.<br>- Always keep hands and clothing away from moving parts.<br>- Does not attempt to measure the temperature rise of a motor by touch but by thermometer, resistance, imbedded detector, or thermocouple. | | |
| | Stop fire | - Identify classes of fires<br>- Select fire extinguishers<br>- Operate fire extinguishers | - Motor Installation<br>o Installation and mounting of motors (mounting, | 10 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Fight fire | coupling, connecting)<br>o Safe use and protection of motors (IEE regulations)<br>o Motor final circuit equipment layout<br>o Selection of motor and control gear<br>o Methods of starting the motors<br>o Maintenance of motors<br>o Testing of motors (insulation resistance test)<br>o Troubleshooting<br>- Motor Rewinding<br>o Taking data<br>o Testing and analysing faults in motors<br>o Dismantling<br>o Removal of windings<br>o Measuring the gauge of the windings | |
| | Follow Safe Test Instrument Working procedure | - Switch the Isolator to the 'OFF' Position or Remove the Plug<br>- Prove the Test Instrument<br>- Prove System Dead<br>- Reprove the Test Instrument, if Possible<br>- Secure the Isolation | | 10 Hours |
| 2) Prepare bill of quantities | Draw wiring lay out diagram | - Visit the site<br>- Take measurements<br>- Sketch ground plan<br>- Draw lay out diagram | | 10 Hours |
| | Estimate quantity and costs of materials | - Quote local market prices of electrical materials<br>- Estimate quantity of electrical materials<br>- Determine the cost of electrical materials<br>- Determine Labour cost<br>- Determine grand total | | 20 Hours |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | | ○ Purchase of winding materials<br>○ Replacement of windings and assembling<br>○ Testing the repaired motor<br>- Motor Control Circuits<br>○ Methods of controlling induction motors (direct on line starter, forward and reverse, automatic star delta starter)<br>- DC Motors<br>○ Construction<br>○ Principles of operation<br>○ Back EMF of a motor<br>○ Types of DC motors and their characteristics<br>○ Reverse of direction of relation of a DC motor | |

| Sub-modules | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | | ○ DC face plate starter and its operation<br>○ Types of speed control<br>- | |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| 1) Install motors | - Install motor | - Select site for the motor or select the motor type for a given site<br>- Select tools and materials<br>- Inspect the motor<br>o Check to be sure that motor has not been exposed to dirt, grit, or excessive moisture in shipment or storage before installation.<br>o Measure insulation resistance.<br>o Clean and dry the windings as required.<br>o Never start a motor which has been wet without having it thoroughly dried.<br>- Floor Mounting<br>o Mount Motor with a firm, | - Single Phase AC motors<br>o Construction<br>o Types of single phase AC motors and their characteristics<br>o Methods of starting single phase AC motors<br>- Three Phase AC Motors<br>o The three phase induction motor construction<br>o Production of a rotating magnetic field and torque slip<br>o Rotor constants, current and copper loss<br>o Torque slip and torque speed characteristics | - 20 Hours |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | rigid foundation.<br>o Follow the manufacturer guidelines for motor mounting.<br>- V-belt drive installation<br>o Select proper type and number of belts and sheaves.<br>o Align sheaves carefully to avoid axial thrust on motor bearing.<br>o Position the drive sheave on the motor toward the motor so that it is as close as possible to the bearing.<br>o Ensure that the motor is secured by all mounting bolts | o Types of three phase induction motors<br>o Starting of induction motors<br>- | |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | before tightening belts.<br>o Adjust belt tension to belt manufacturer's recommendations.<br>- Install isolator<br>- Install circuit board<br>- Install control panel. | | |
| | Install motor starters | - Direct On Line Stater<br>o Draw the power circuit<br>o Draw the control circuit<br>o Select tools and materials<br>o Wire the starter<br>- Forward and Reverse Starter<br>o Draw the power circuit<br>o Draw the control circuit<br>o Select tools and materials | - | 20 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | ○ Wire the starter<br>- Star Delta Starter<br>○ Draw the power circuit<br>○ Draw the control circuit<br>○ Select tools and materials<br>○ Wire the starter | | |
| 2) Maintain motors | - Dismantle and assemble the motor | - Select tools<br>- Observe safety<br>- Remove terminal box cover and cooling fan cover<br>- Remove front and back cover nut bolts<br>- Mark front and back covers<br>- Remove front cover<br>- Remove fan locker<br>- Remove rotor with back cover from the stator<br>- Remove back cover from the rotor shaft | - | 10 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Remove non-driving end bearing from the shaft<br>- Remove bearing back cover<br>- Remove bearing front cover<br>- Clean both covers and rotor shaft<br>- Apply grease on both sides of the rotor shaft and bearing housings<br>- Install old or new bearing on the front cover<br>- Install front cover with bearing on the shaft<br>- Install the non-driving end bearing on the shaft<br>- Install rotor inside the stator with front cover<br>- Install back cover<br>- Tighten front and back cover nuts and bolts | | |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Observe free rotation of the shaft<br>- Clean and Installs cooling fan locker(key)<br>- Install the cooling fan<br>- Install fan lock<br>- Install cooling fan cover | | |
| | - Inspect motor | - Check alignment.<br>- Check lose connection<br>- Examine brushes<br>- Check motor temperature.<br>- Check motor speed<br>- Check that the bearings are in good condition and operating properly.<br>- Ensure that there is no mechanical obstruction to prevent rotation in the motor or in the driven load. | - | 20 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Ensure that all bolts and nuts are tightened securely.<br>- Ensure that the line voltage and frequency correspond to the voltage and frequency stamped on the nameplate of the motor.<br>- Ensure that the voltage is actually available at motor terminals.<br>- Ensure that the fuses and other protective devices are in proper condition.<br>- Ensure that All connections and contacts are properly made in the circuits between the control apparatus and motor. | | |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | - Test motor | - Carryout open circuit test.<br>- Carryout short circuit test.<br>- Carryout grounding test | - | 20 Hours |
| | - Lubricate motor | - Stop motor.<br>- Disconnect and lock out of service.<br>- Remove contaminants from grease inlet area.<br>- Remove filler and drain plugs.<br>- Check filler and drain holes for blockage and clean as necessary.<br>- Add proper type and amount of grease.<br>- Wipe off excess grease and replace filler and drain plugs | - | 10 Hours |
| 3) Rewind motor | - Rewind stator, rotor | - Select tools and materials | - | 30 Hours |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | and armature | - Record information from the name plate.<br>- Disassemble motor<br>- Record data of stator/rotor/armature windings.<br>- Draw schematic diagram of the old/original connection<br>- Remove the old windings<br>- Insert the rectangular shaped paper insulation in the slots<br>- Make a circular winding pattern of the same diameter and same number of turns with the original<br>- Insert the circular patterned coil to the slots | | |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Connect an extension wire to the terminals<br>- Tie and fix the windings<br>- Apply an insulating varnish to the new windings and let it dry<br>- Solder joints.<br>- Test the continuity of the windings<br>- Terminates the necessary terminals based on the schematic diagram drawn before the winding was dismantled<br>- Reassemble the motor<br>- Make report. | | |
| 4) Troubleshoot motor | Motor fails to start | - Check fuses with proper type and rating<br>- Check and reset overload in starter. | - | 20 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Check to see that power supplied agrees with motor nameplate and load factor.<br>- Check for proper line connections with the diagram supplied with motor.<br>- Open circuit in winding or control switch Indicated by humming sound when switch is closed.<br>- Check for loose wiring connections.<br>- Check that all control contacts are closing.<br>- Check to see if motor and drive turn freely.<br>- Check bearings and lubrication.<br>- Check for Short circuited stator indicated by blown fuses. | | |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Check for Poor stator coil connection<br>- Look for broken bars or end rings.<br>- Reduce the load if the motor is overloaded. | | |
| | Motor stalls | - Check lines for open phase.<br>- Reduce load to reduce overload.<br>- Check connection for Low voltage<br>- Check overload relay, stator and pushbuttons for open circuit or fuses blown | - | 10 Hours |
| | Motor overheats while running under load | - Reduce load.<br>- Open vent holes and check for a continuous stream of air from the motor.<br>- Check to make sure that all leads are well connected.<br>- Locate and repair grounded coil. | - | 10 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | - Check for faulty leads and connections. | | |
| | Motor vibrates | - Realign the motor.<br>- Strengthen base against weak support<br>- Balance coupling.<br>- Rebalance driven equipment.<br>- Replace defective bearing.<br>- Line up bearing properly.<br>- Check for open circuit.<br>- Adjust bearing or add shim. | - | 10 Hours |
| | Scraping noise | - Remove interference causing the fan to rub air shield.<br>- Clear fan from striking insulation.<br>- Tighten holding bolts causing loose on bed plate. | - | 10 Hours |

| **Duties** | **Tasks** | **Competences** | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | Hot bearings and bearings ball | - Bent or sprung shaft Straighten or replace shaft.<br>- Decrease belt tension to reduce excessive belt pull.<br>- Move pulley closer to motor bearing.<br>- Realign the drive.<br>- Maintain proper quantity of grease in bearing.<br>- Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.<br>- Reduce quantity of grease in case of excess lubricant<br>- Check alignment, side and end thrust for overloaded bearing.<br>- Replace bearing in case of broken | - | 10 Hours |

| Duties | Tasks | Competences | Syllabus Indicative Content | Duration |
|---|---|---|---|---|
| | | ball or rough races. | | |

Assessment

The module will be assessed through practical work, assignments, tests and final assessment. Their relative contribution to the final grade is as below:

| Requirements | Contribution |
|---|---|
| Assignments | 5% |
| Tests | 10% |
| Practical work | 25% |
| Final assessment | 60% |
| Total | 100% |

**END**