
# NATIONAL CERTIFICATES (VOCATIONAL)

## ASSESSMENT GUIDELINES

## ELECTRO TECHNOLOGY

## NQF Level 3

April 2008

# CONTENTS

## SECTION A: PURPOSE OF THE SUBJECT ASSESSMENT GUIDELINES

This document provides the lecturer with guidelines to develop and implement a coherent, integrated assessment system for Electro Technology in the National Certificates (Vocational). It must be read with the *National Policy Regarding Further Education and Training Programmes: Approval of the Documents, Policy for the National Certificates (Vocational) Qualifications at Levels 2 to 4 on the National Qualifications Framework (NQF)*. This assessment guideline will be used for National Qualifications Framework Levels 2-4.

This document explains the requirements for the internal and external subject assessment. The lecturer must use this document with the *Subject Guidelines: Electro Technology* to prepare for and deliver Electro Technology. Lecturers should use a variety of resources and apply a range of assessment skills in the setting, marking and recording of assessment tasks.

## SECTION B: ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

### 1 ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

Assessment in the National Certificates (Vocational) is underpinned by the objectives of the National Qualifications Framework (NQF). These objectives are to:

- Create an integrated national framework for learning achievements.
- Facilitate access to and progression within education, training and career paths.
- Enhance the quality of education and training.
- Redress unfair discrimination and past imbalances and thereby accelerate employment opportunities.
- Contribute to the holistic development of the student by addressing:
  - social adjustment and responsibility;
  - moral accountability and ethical work orientation;
  - economic participation; and
  - nation-building.

The principles that drive these objectives are:

- ***Integration***

To adopt a unified approach to education and training that will strengthen the human resources development capacity of the nation.

- ***Relevance***

To be dynamic and responsive to national development needs.

- ***Credibility***

To demonstrate national and international value and recognition of qualification and acquired competencies and skills.

- ***Coherence***

To work within a consistent framework of principles and certification.

- ***Flexibility***

To allow for creativity and resourcefulness when achieving Learning Outcomes, to cater for different learning styles and use a range of assessment methods, instruments and techniques.

- ***Participation***

To enable stakeholders to participate in setting standards and co-ordinating the achievement of the qualification.

- ***Access***

To address barriers to learning at each level to facilitate students' progress.

- ***Progression***

To ensure that the qualification framework permits individuals to move through the levels of the national qualification via different, appropriate combinations of the components of the delivery system.

- ***Portability***

To enable students to transfer credits of qualifications from one learning institution and/or employer to another institution or employer.

- ***Articulation***

To allow for vertical and horizontal mobility in the education system when accredited pre-requisites have been successfully completed.

- ***Recognition of Prior Learning***

To grant credits for a unit of learning following an assessment or if a student possesses the capabilities specified in the outcomes statement.

- ***Validity of assessments***

To ensure assessment covers a broad range of knowledge, skills, values and attitudes (SKVAs) needed to demonstrate applied competency. This is achieved through:

  - clearly stating the outcome to be assessed;
  - selecting the appropriate or suitable evidence;
  - matching the evidence with a compatible or appropriate method of assessment; and
  - selecting and constructing an instrument(s) of assessment.

- ***Reliability***

To assure assessment practices are consistent so that the same result or judgment is arrived at if the assessment is replicated in the same context. This demands consistency in the interpretation of evidence; therefore careful monitoring of assessment is vital.

- ***Fairness and transparency***

To verify that no assessment process or method(s) hinders or unfairly advantages any student. The following could constitute unfairness in assessment:

  - Inequality of opportunities, resources or teaching and learning approaches
  - Bias based on ethnicity, race, gender, age, disability or social class
  - Lack of clarity regarding Learning Outcome being assessed
  - Comparison of one student's work with another, based on learning styles and language

- ***Practicability and cost-effectiveness***

To integrate assessment practices within an outcomes-based education and training system and strive for cost and time-effective assessment.

## 2 ASSESSMENT FRAMEWORK FOR VOCATIONAL QUALIFICATIONS

The assessment structure for the National Certificates (Vocational) qualification is as follows:

### 2.1 Internal continuous assessment (ICASS)

Knowledge, skills values, and attitudes (SKVAs) are assessed throughout the year using assessment instruments such as projects, tests, assignments, investigations, role-play and case studies. The internal continuous assessment (ICASS) practical component is undertaken in a real workplace, a workshop or a "Structured Environment". This component is moderated internally, and externally quality assured by Umalusi. All internal continuous assessment evidence is kept in a Portfolio of Evidence (PoE) and must be readily available for monitoring, moderation and verification purposes.

### 2.2 External summative assessment (ESASS)

The external summative assessment is either a single paper or set of written papers set to the requirements of the Subject Learning Outcomes. The Department of Education administers the theoretical component according to relevant assessment policies.

A compulsory component of external summative assessment (ESASS) is the **integrated summative assessment task (ISAT)**. This assessment task draws on the student's cumulative learning throughout the year. The task requires **integrated application of competence** and is executed under strict assessment conditions. The task should take place in a simulated or "Structured Environment". The integrated summative assessment task is the most significant test of students' ability to apply acquired knowledge.

The integrated assessment approach allows students to be assessed in more than one subject with the same integrated summative assessment task.

External summative assessments will be conducted annually between October and December, with provision made for supplementary sittings.

## 3 MODERATION OF ASSESSMENT

### 3.1 Internal moderation

Assessment must be moderated according to the internal moderation policy of the Further Education and Training (FET) college. Internal college moderation is a continuous process. The moderator's involvement starts with the planning of assessment methods and instruments and follows with continuous collaboration with and support to the assessors. Internal moderation creates common understanding of Assessment Standards and maintains these across vocational programmes.

### 3.2 External moderation

External moderation is conducted by the Department of Education, Umalusi and, where relevant, an Education and Training Quality Assurance (ETQA) body according to South African Qualifications Authority (SAQA) and Umalusi standards and requirements.

The external moderator:

- monitors and evaluates the standard of all summative assessments;
- maintains standards by exercising appropriate influence and control over assessors;
- ensures proper procedures are followed;
- ensures summative integrated assessments are correctly administered;
- observes a minimum sample of ten (10) to twenty-five (25) percent of summative assessments;
- gives written feedback to the relevant quality assuror; and
- moderates in case of a dispute between an assessor and a student.

Policy on inclusive education requires that assessment procedures be customised for students who experience barriers to learning, and supported to enable these students to achieve their maximum potential.

## 4 PERIOD OF VALIDITY OF INTERNAL CONTINUOUS ASSESSMENT (ICASS)

The period of validity of the internal continuous assessment mark is determined by the *National Policy on the Conduct, Administration and Management of the Assessment of the National Certificates (Vocational).*

The internal continuous assessment (ICASS) must be re-submitted with each examination enrolment for which it constitutes a component.

## 5 ASSESSOR REQUIREMENTS

Assessors must be subject specialists and should ideally be declared competent against the standards set by the ETDP SETA. If the lecturer conducting the assessments has not been declared a competent assessor, an assessor who has been declared competent may be appointed to oversee the assessment process to ensure the quality and integrity of assessments.

## 6 TYPES OF ASSESSMENT

Assessment benefits the student and the lecturer. It informs students about their progress and helps lecturers make informed decisions at different stages of the learning process. Depending on the intended purpose, different types of assessment can be used.

### 6.1 Baseline assessment

At the beginning of a level or learning experience, baseline assessment establishes the knowledge, skills, values and attitudes (SKVAs) that students bring to the classroom. This knowledge assists lecturers to plan learning programmes and learning activities.

### 6.2 Diagnostic assessment

This assessment diagnoses the nature and causes of learning barriers experienced by specific students. It is followed by guidance, appropriate support and intervention strategies. This type of assessment is useful to make referrals for students requiring specialist help.

### 6.3 Formative assessment

This assessment monitors and supports teaching and learning. It determines student strengths and weaknesses and provides feedback on progress. It determines if a student is ready for summative assessment.

### 6.4 Summative assessment

This type of assessment gives an overall picture of student progress at a given time. It determines whether the student is sufficiently competent to progress to the next level.

## 7 PLANNING ASSESSMENT

An assessment plan should cover three main processes:

### 7.1 Collecting evidence

The assessment plan indicates which Subject Outcomes and Assessment Standards will be assessed, what assessment method or activity will be used and when this assessment will be conducted.

### 7.2 Recording

Recording refers to the assessment instruments or tools with which the assessment will be captured or recorded. Therefore, appropriate assessment instruments must be developed or adapted.

### 7.3 Reporting

All the evidence is put together in a report to deliver a decision for the subject.

## 8 METHODS OF ASSESSMENT

Methods of assessment refer to who carries out the assessment and includes lecturer assessment, self-assessment, peer assessment and group assessment.

| | |
|---|---|
| **LECTURER ASSESSMENT** | The lecturer assesses students' performance against given criteria in different contexts, such as individual work, group work, etc. |
| **SELF-ASSESSMENT** | Students assess their own performance against given criteria in different contexts, such as individual work, group work, etc. |
| **PEER ASSESSMENT** | Students assess another student's or group of students' performance against given criteria in different contexts, such as individual work, group work, etc. |
| **GROUP ASSESSMENT** | Students assess the individual performance of other students within a group or the overall performance of a group of students against given criteria. |

## 9 INSTRUMENTS AND TOOLS FOR COLLECTING EVIDENCE

All evidence collected for assessment purposes is kept or recorded in the student's Portfolio of Evidence (PoE).

The following table summarises a variety of methods and instruments for collecting evidence. A method and instrument is chosen to give students ample opportunity to demonstrate that the Subject Outcome has been attained. This will only be possible if the chosen methods and instruments are appropriate for the target group and the Specific Outcome being assessed.

| | METHODS FOR COLLECTING EVIDENCE | | |
|---|---|---|---|
| | **Observation-based** (Less structured) | **Task-based** (Structured) | **Test-based** (More structured) |
| **Assessment instruments** | • Observation<br>• Class questions<br>• Lecturer, student, parent discussions | • Assignments or tasks<br>• Projects<br>• Investigations or research<br>• Case studies<br>• Practical exercises<br>• Demonstrations<br>• Role-play<br>• Interviews | • Examinations<br>• Class tests<br>• Practical examinations<br>• Oral tests<br>• Open-book tests |
| **Assessment tools** | • Observation sheets<br>• Lecturer's notes<br>• Comments | • Checklists<br>• Rating scales<br>• Rubrics | • Marks (e.g. %)<br>• Rating scales (1-5) |
| **Evidence** | • Focus on individual students<br>• Subjective evidence based on lecturer observations and impressions | **Open middle**: Students produce the same evidence but in different ways.<br>**Open end**: Students use same process to achieve different results. | Students answer the same questions in the same way, within the same time. |

## 10 TOOLS FOR ASSESSING STUDENT PERFORMANCE

**Rating scales** are marking systems where a symbol (such as 1 to 5) or a mark (such as 5/10 or 50%) is defined in detail. The detail is as important as the coded score. Traditional marking, assessment and evaluation mostly used rating scales without details such as what was right or wrong, weak or strong, etc.

**Task lists** and **checklists** show the student what needs to be done. These consist of short statements describing the expected performance in a particular task. The statements on the checklist can be ticked off when the student has adequately achieved the criterion. Checklists and task lists are useful in peer or group assessment activities.

**Rubrics** are a hierarchy (graded levels) of criteria with benchmarks that describe the minimum level of acceptable performance or achievement for each criterion. Using rubrics provides a different way of assessing that cannot be compared to tests. Each criterion described in the rubric must be assessed separately. Mainly two types of rubrics, namely holistic and analytical, are used.

## 11 SELECTING AND/OR DESIGNING RECORDING AND REPORTING SYSTEMS

The selection or design of recording and reporting systems depends on the purpose of recording and reporting student achievement. **Why** particular information is recorded and **how** it is recorded determine which instrument will be used.

Computer-based systems, for example spreadsheets, are cost and time effective. The recording system should be user-friendly and information should be easily accessed and retrieved.

## 12 COMPETENCE DESCRIPTIONS

All assessment should award marks to evaluate specific assessment tasks. However, marks should be awarded against rubrics and not be simply a total of ticks for right answers. Rubrics should explain the competence level descriptors for the skills, knowledge, values and attitudes (SKVAs) that a student must demonstrate to achieve each level of the rating scale.

When lecturers or assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a Subject Outcome. The relevant Assessment Standard must be used to create the rubric to assess the task or question. The descriptions must clearly indicate the minimum level of attainment for each category on the rating scale.

## 13 STRATEGIES FOR COLLECTING EVIDENCE

A number of different assessment instruments may be used to collect and record evidence. Examples of instruments that can be (adapted and) used in the classroom include:

### 13.1 Record sheets

The lecturer observes students working in a group. These observations are recorded in a summary table at the end of each project. The lecturer can design a record sheet to observe students' interactive and problem-solving skills, attitudes towards group work and involvement in a group activity.

### 13.2 Checklists

Checklists should have clear categories to ensure that the objectives are effectively met. The categories should describe how the activities are evaluated and against which criteria they are evaluated. Space for comments is essential.

# SECTION C: ASSESSMENT IN ELECTRO TECHNOLOGY

## 1 SCHEDULE OF ASSESSMENT

At NQF levels 2, 3 and 4, lecturers will conduct assessments as well as develop a schedule of formal assessments that will be undertaken in the year. All three levels also have an external examination that accounts for 50 percent of the total mark. The marks allocated to assessment tasks completed during the year, kept or recorded in a Portfolio of Evidence account for the other 50 percent.

The Portfolio of Evidence and the external assessment include practical and written components. The practical assessment in Electro Technology must, where necessary, be subjected to external moderation by Umalusi or an appropriate Education and Training Quality Assurance (ETQA) body, appointed by the Umalusi Council in terms of Section 28(2) of the *General and Further Education and Training Quality Assurance Act, 2001 (Act No. 58 of 2001).*

## 2 RECORDING AND REPORTING

Electro Technology, as is the case for all the other Vocational subjects, is assessed according to five levels of competence. The level descriptions are explained in the following table.

***Scale of Achievement for the Vocational component***

| RATING CODE | RATING | MARKS % |
|---|---|---|
| 5 | Outstanding | 80-100 |
| 4 | Highly competent | 70-79 |
| 3 | Competent | 50-69 |
| 2 | Not yet competent | 40-49 |
| 1 | Not achieved | 0-39 |

The programme of assessment should be recorded in the Lecturer's Portfolio of Assessment for each subject. The following at least should be included in the Lecturer's Assessment Portfolio:

- A contents page
- The formal schedule of assessment
- The requirements for each assessment task
- The tools used for each assessment task
- Recording instrument(s) for each assessment task
- A mark sheet and report for each assessment task

The college must standardise these documents.

The student's Portfolio of Evidence must include at least:

- A contents page
- The assessment tasks according to the assessment schedule
- The assessment tools or instruments for the task
- A record of the marks (and comments) achieved for each task

Where a task cannot be contained as evidence in the Portfolio of Evidence, its exact location must be recorded and it must be readily available for moderation purposes.

The following units guide internal assessment in Electro Technology Level 3:

| NUMBER OF UNITS | ASSESSMENT | COVERAGE |
|---|---|---|
| 3 | Formal written tests | One or more completed topics |
| 1 | Internal written exam | All completed topics |
| 3 | Practical assessments | Must cover the related Subject Outcomes<br>1.2 The application of Control Methods.<br>2.2 The application of safety technology in drive control circuits.<br>3.1 Installation in accordance with SABS 0142 code of practice, testing for operation, and safety tests.<br>4.1 Application of relay logic control circuits.<br>5.1 Applied procedures whilst repairing, maintaining and commissioning electric drive related circuits, correct diagnoses and systems repaired.<br>5.2 Commissioning related faults that occur in electrical sub systems. |

# ASSESSMENT OF ELECTRO TECHNOLOGY

# LEVEL 3

## 3 INTERNAL ASSESSMENT OF SUBJECT OUTCOMES IN ELECTRO TECHNOLOGY – LEVEL 3

### Topic 1: Describe the fundamentals of drive technology and related control methods and circuits

**SUBJECT OUTCOME**

**1.1 Describe and apply drive technology**

*Range: Fundamentals: magnetism in motors/generator principles (Faraday and Lenz's laws). Electric drive types: DC drives: Series, compound, shunt and permanent magnet type. AC drives: Induction, universal type coupling methods including belt-, gear- and direct drives*

| ASSESSMENT STANDARDS | LEARNING OUTCOMES |
|---|---|
| • The following are described:<br>▪ the fundamental operation of rotary and linear AC/DC electric drives<br>▪ the basic construction of electric drives<br>▪ the application of the various drive types<br>▪ the importance of name plates and indicate the information given<br>▪ how different terminal connections (series, shunt and compound field ) can be made to connect motors<br>▪ the IP rating on various motor types<br>▪ the various mounting methods and procedure of electric drives.<br>▪ the energy conversion that takes place in an electric drive.<br>• Various drive symbols are drawn and interpreted.<br>• Various drive couplings employed in electric drive applications are identified and described.<br>• Various motor types are identified in accordance with their connection terminals.<br>• Electric drive parts are identified and their purpose and operation explained.<br>• An electric drive is identified and selected using all the characteristics above.<br>• The correct drive is selected by means of the name plate, a motor selected in accordance with its mounting method and IP rating.<br>• Drive speed is determined by means of calculation and coupling methods, and electric drive efficiency determined by calculation. | • Describe<br>▪ the fundamental operation of rotary and linear AC/DC electric drives.<br>▪ the basic construction of electric drives.<br>▪ the application of the various drive types.<br>▪ the importance of name plates and indicate the information given.<br>▪ how different terminal connections (series, shunt and compound field) can be made to connect motors<br>▪ the IP rating on various motor types.<br>▪ the various mounting methods and procedure of electric drives.<br>▪ the energy conversion that takes place in an electric drive.<br>• Draw and interpret various drive symbols.<br>• Identify<br>▪ and describe various drive couplings employed in electric drive applications.<br>▪ various motor types in accordance with their connection terminals.<br>▪ electric drive parts and explain their purpose and operation.<br>▪ and select an electric drive using all the characteristics above.<br>• Select<br>▪ the correct drive by means of the name plate.<br>▪ a motor in accordance with its mounting method.<br>▪ a motor in accordance with its IP rating.<br>• Determine<br>▪ drive speed by means of calculation and coupling methods.<br>▪ electric drive efficiency by calculation. |

**ASSESSMENT TASKS OR ACTIVITIES**

- Assignments or tasks and an open-book test on the concepts and terminology
- Demonstrations on the selection of correct drives by means of the name plate, a motor in accordance with its mounting method and its IP rating.

**SUBJECT OUTCOME**

**1.2 Describe and apply control methods**

*Range: Speed control, reversal of direction, direct on line starting, resistance starting. Relay/contactor control circuits (timer, sequential starting, latching, sequential/cascaded control and safety circuits. Sensors. Limit switches and proximity switches*

| ASSESSMENT STANDARDS | LEARNING OUTCOMES |
|---|---|
| • Various electric drive control methods are explained and identified<br>• The following are explained:<br>▪ what is meant by main and related control circuits.<br>▪ the wiring and terminal marking of relays/contactors/timers/counters/indication and protection devices encountered with drive control.<br>▪ how sensors can be used in the control of electrical drive control.<br>• Basic relay/contactor control circuits and related components are designed, drawn and explained.<br>• The operation of various commonly used sensors used in electric drive control applications are identified and explained.<br>• Control gears are identified and selected for drive control circuits.<br>• Correct electric drives are identified and selected for given application.<br>• Relevant sensors are identified and selected for various control applications.<br>• Basic electric drive control circuits are designed and drawn. | • Explain<br>▪ and identify the various electric drive control methods.<br>▪ what is meant by main and related control circuits.<br>▪ the wiring and terminal marking of relays/contactors/timers/counters/indication and protection devices encountered with drive control.<br>▪ how sensors can be used in the control of electrical drive control.<br>• Design, draw and explain basic relay/contactor control circuits and related components.<br>• Identify and<br>▪ explain the operation of various sensors commonly used in electric drive control applications.<br>▪ and select control gears for drive control circuits.<br>▪ and select correct electric drives for given application.<br>▪ and select relevant sensors for various control applications.<br>• Design and draw basic electric drive control circuits. |
| **ASSESSMENT TASKS OR ACTIVITIES** | |
| • Demonstrations and practical exercises on the application of control methods.<br>• Comments, checklists and rubrics on the Learning Outcomes | |

### Topic 2: Describe and apply related electrical safety technology

| SUBJECT OUTCOME | |
|---|---|
| **2.1 Explain and select general electrical safety technology**<br>*Range: SABS 0142* | |
| **ASSESSMENT STANDARDS** | **LEARNING OUTCOMES** |
| • Protection methods employed against direct and indirect electric dangers are explained.<br>• Low voltage protection, protection devices used against over current and against leakage current are explained.<br>• The term protective insulation is explained, and what is meant by earthing and bonding, protection by isolation and the importance of earth electrodes.<br>• The various components used for protection in an electrical application are identified and listed.<br>• Correct protection components are selected in accordance with their required ratings. | • Explain<br>▪ the protection methods employed against direct and indirect electric dangers.<br>▪ how low voltage protection is achieved.<br>▪ the protection devices used against over current.<br>▪ how protection is achieved against leakage current.<br>▪ what is meant by the term protective insulation.<br>▪ what is meant by earthing and bonding.<br>▪ protection by isolation.<br>▪ the importance of earth electrodes<br>• Identify and list the various components used for protection in an electrical application.<br>• Select correct protection components in accordance with their required ratings. |
| **ASSESSMENT TASKS OR ACTIVITIES** | |
| • Class questions, assignments, demonstrations and an open-book test on the explanation and selection of general electrical safety technology. | |

| SUBJECT OUTCOME | |
|---|---|
| **2.2 Describe and apply safety technology in drive control circuits**<br>*Range: Safety functions: Stop function, emergency stop/halt functions, reset, start and restart, related response times. Machine safety related to SABS 0142* | |
| **ASSESSMENT STANDARDS** | **LEARNING OUTCOMES** |
| • The following are explained:<br>▪ the safety function with respect to electric drive control.<br>▪ the safety related parameters related to safety functions.<br>▪ what is meant by a two handed control in machine control safety circuits.<br>▪ various safety interlocking systems and their related circuit diagrams.<br>▪ the fault finding safety procedures to employ when working on electrical drives and related control circuits.<br>▪ related design and application regulations in respect of safety in the SABS 0142 Code of Practice.<br>• Possible failures in closed loop and in open loop control circuits are listed.<br>• Electric drive safety is applied when installing, testing, maintaining and fault finding.<br>• Relevant SABS 0142 Code of Practice is applied when working on electrical drive systems. | • Explain<br>▪ the safety function with respect to electric drive control.<br>▪ the safety related parameters related to safety functions.<br>▪ what is meant by a two handed control in machine control safety circuits.<br>▪ various safety interlocking systems and their related circuit diagrams.<br>▪ the fault finding safety procedures to employ when working on electrical drives and related control circuits.<br>▪ related design and application regulations in respect of safety in the SABS 0142 Code of Practice.<br>• List possible failures in closed loop and in open loop control circuits.<br>• Apply electric drive safety when installing, testing, maintaining and fault finding.<br>• Apply relevant SABS 0142 Code of Practice when working on electrical drive systems. |
| **ASSESSMENT TASKS OR ACTIVITIES** | |
| • Practical exercises on the application of safety technology in drive control circuits.<br>• Demonstrations and observation sheets on Learning Outcomes. | |

## Topic 3: Install and test electro-technical systems that employ electric drives, switches and control technology

| SUBJECT OUTCOME | |
|---|---|
| **3.1 Plan, install and test electric drive control sub-systems** | |
| **ASSESSMENT STANDARDS** | **LEARNING OUTCOMES** |
| • The planning procedure for installing electric drive related control circuits is explained.<br>• The relevant installation regulations are explained with respect to SABS 0142.<br>• Various procedures for testing an electric drive control sub-system are explained.<br>• Electrical diagrams and instructions are read and interpreted.<br>• The installation of electric drive control sub-systems is planned for.<br>• A tool list, materials list, safety requirements and work process should be identified and drawn up.<br>• Installation is performed in accordance with SABS 0142 Code of Practice.<br>• The installation is tested for operation.<br>• Relevant safety tests are applied as recommended by the SABS 0142. | • Explain<br>▪ the planning procedure for installing electric drive related control circuits.<br>▪ the relevant installation regulations with respect to SABS 0142.<br>▪ the various procedures for testing an electric drive control sub-system.<br>• Read and interpret electrical diagrams and instructions.<br>• Plan for the installation of electric drive control sub-systems.<br>• Draw up<br>▪ a tool list.<br>▪ and list the required safety considerations<br>• Identify and draw up<br>▪ a materials list<br>▪ a tool list<br>▪ work processes<br>• Perform the installation in accordance with SABS 0142 Code of Practice.<br>• Test the installation for operation.<br>• Apply relevant safety tests as recommended by the SABS 0142. |

| ASSESSMENT TASKS OR ACTIVITIES |
|---|
| • Assignments or tasks on the planning procedure, electrical diagrams and instructions.<br>• A project on the tool list, the required safety considerations and a materials list and work process.<br>• Case studies on installation regulations with respect to SABS 0142.<br>• Practical exercises on installation in accordance with SABS 0142 Code of Practice, testing for operation, and safety tests. |

## Topic 4: Design relay ladder logic related control circuits as used in electric drive control technology

| SUBJECT OUTCOME | |
|---|---|
| **4.1 Describe and apply relay logic control circuits**<br>*Range: Sequential starting of conveyor belt systems, indication of system on/off, cascaded timers, automatic off/on circuits- clock /timer/counter control, sorting, testing, and transporting control circuits, direction of drive reversal, pick and place control.* | |
| **ASSESSMENT STANDARDS** | **LEARNING OUTCOMES** |
| • Control symbols, the importance of understanding relay logic control application circuits, and the meaning of final drive control components are explained, and these components listed.<br>• A basic control circuit diagram is designed and drawn in conjunction with the main electric drive circuit.<br>• All terminal connections are shown for the components<br>• Components labelling for cubicle/installation diagrams and wiring diagrams is shown. | • Explain<br>▪ the related control symbols.<br>▪ the importance of understanding relay logic control application circuits.<br>▪ what is meant by final drive control components and list these components<br>• Design and draw a basic control circuit diagram in conjunction with the main electric drive circuit.<br>• Show all terminal connections for the components used.<br>• Show how all the components are labelled in a cubicle/installation diagram and a wiring diagram. |
| **ASSESSMENT TASKS OR ACTIVITIES** | |
| • Observation and checklists to describe relay logic control circuits.<br>• Practical exercises to apply relay logic control circuits | |

## Topic 5: Maintain and commission installations that employ electric drives, switches and control circuits

| SUBJECT OUTCOME | |
|---|---|
| **5.1 Explain and apply diagnostic procedures for electrical drive control sub-systems**<br>*Range: rating plate, motor not starting –dead/hum/slow/protection devices trip, wrong direction, bearing noise ; interrupted motor protection switch, burning signs evident, motor is burnt; (contactor/relay does not pick up, sticking relay, worn out/ burnt contacts, sparking contacts; closed switch no flow, contact sparking, high resistance, coil not energised, contacts not operating, relay hum; wiring low voltage, protection devices tripping, line heats up* | |
| **ASSESSMENT STANDARDS** | **LEARNING OUTCOMES** |
| • An explanation is given of how the rating plate can be used in fault diagnosis.<br>• The following procedures are explained:<br>▪ the procedure to follow when the motor does not start (dead motor).<br>▪ the starting procedure when a motor does not start (motor not dead).<br>▪ the procedure to follow when a motor starts but gets hot or hums when running.<br>▪ the procedure to follow when a motor starts and thermal trip takes place after a while.<br>▪ the procedure to follow when a motor has bearing noise.<br>▪ the procedure to rectify a motor going in the wrong direction prior to commissioning.<br>▪ various fault related procedures to protect switches and thermal over-current relays.<br>▪ the various procedures related to contactor/relay faults.<br>▪ the various procedures related to switching devices.<br>▪ related procedures with respect to wiring.<br>• Various related procedures are applied whilst repairing, maintaining and commissioning electric drive related circuits.<br>• Correct diagnoses are made and systems repaired.<br>• A fault report is filled out including identification, actions taken, and the total cost of labour and materials. | • Explain<br>▪ how the rating plate can be used in fault diagnosis.<br>▪ the procedure to follow when the motor does not start (dead motor).<br>▪ the starting procedure when a motor does not start (motor not dead).<br>▪ the procedure to follow when a motor starts but gets hot or hums when running.<br>▪ the procedure to follow when a motor starts and thermal trip takes place after a while.<br>▪ the procedure to follow when a motor has bearing noise.<br>▪ the procedure to rectify a motor going in the wrong direction prior to commissioning.<br>▪ various fault related procedures to protect switches and thermal over-current relays.<br>▪ the various procedures related to contactor/relay faults.<br>▪ the various procedures related to switching devices.<br>▪ related procedures with respect to wiring.<br>• Apply the various related procedures whilst repairing, maintaining and commissioning electric drive related circuits.<br>• Make correct diagnoses and repair systems.<br>• Fill out a fault report including identification, actions taken, and the total cost of labour and materials. |
| **ASSESSMENT TASKS OR ACTIVITIES** | |
| • Demonstrations and projects on fault diagnosis and procedures.<br>• A case study on fault reports.<br>• Practical exercises and rubrics on applied procedures whilst repairing, maintaining and commissioning electric drive related circuits, correct diagnoses and systems repaired. | |

| SUBJECT OUTCOME |
|---|
| **5.2 Commission faults that occur in electric sub-systems**<br>*Range: Linear drives: failure to observe installation instruction, improper electrical wiring, emergency stop engaged, safety device tripped, faults in installation and alignments. Rotary drives: Improper electrical wiring, wrong direction, low starting current, e/stop engaged, failure to observe installation instructions, fault in assembly of output element (gears, spindle, shaft, belt drive), safety devices tripped, faults in installation and alignment. No noise damping, fan does not start simultaneously, external; cooling not connected, motor at insufficient speed. Energy control section: Switching device- incorrect coil voltage, voltage type, wiring, setting for timers. Counters Control devices- incorrect switch position, improper wiring, contact reversal, contact stuck. Protective device- links/fuses not inserted, incorrect settings, protection systems tripped. Energy supply section: Energy generation- too complex for this level. Energy storage- batteries, generating plant standby, large capacitors –to be commissioned in accordance with code and regulations. Energy distribution- cable faults, solder termination dry, terminals screwed connections loose, defective insulation. Signal section: Mechanical position switches- wrong switch position, contact stuck/burnt, wire open circuit, insulation open. Proximity switches- wrong position, wire break, insulation open, contact stuck, sensor contaminated (dust, chemicals, etc), sensor reversed, cable reversed, magnetic field disturbance, adjustment needed. Pressure switches: missing seals, improper assembly, electrical terminals reversed, incorrect pressure adjustment, insulation* |

| *stripped, incorrect pressure range* | |
|---|---|
| **ASSESSMENT STANDARDS** | **LEARNING OUTCOMES** |
| • Three possible places where commissioning faults can occur are listed.<br>• Possible faults that can occur in the energy control section, the energy supply section, the electric drive section (linear/rotary) and in the signal section are listed.<br>• Various commissioning related faults that occur in electric sub systems are diagnosed and repaired. | • List the three possible places where commissioning faults can occur.<br>• List possible faults that can occur<br>▪ in the energy control section<br>▪ in the energy supply section<br>▪ in the electric drive section (linear/rotary)<br>▪ in the signal section.<br>• Diagnose and repair various commissioning related faults that occur in electric sub systems. |
| **ASSESSMENT TASKS OR ACTIVITIES** | |
| • Investigations or research on commissioning faults in the energy control section, in the energy supply section, in the electric drive section (linear/rotary) and in the signal section.<br>• Practical exercises on commissioning related faults that occur in electrical sub systems | |

## 4 SPECIFICATIONS FOR EXTERNAL ASSESSMENT IN ELECTRO TECHNOLOGY – LEVEL 3

### 4.1 Integrated summative assessment task (ISAT)

A compulsory component of the external assessment (ESASS) is the **integrated summative assessment task (ISAT)**. The integrated summative assessment task draws on the student's cumulative learning achieved throughout the year. The task requires integrated application of competence and is executed and recorded in compliance with assessment conditions.

Two approaches to the integrated summative assessment task (ISAT) may be as follows:

- The students are assigned a task at the beginning of the year which they will have to complete in phases throughout the year to obtain an assessment mark. A final assessment is made at the end of the year when the task is completed.

**OR**

- Students achieve the competencies throughout the year but the competencies are assessed cumulatively in a single assessment or examination session at the end of the year.

The integrated summative assessment task is set by an externally appointed examiner and is conveyed to colleges in the first quarter of the year.

The integrated assessment approach enables students to be assessed in more than one subject with the same integrated summative assessment task.

### 4.2 National Examination

A national examination is conducted annually in October or November by means of a paper(s) set and moderated externally. The following distribution of cognitive application is suggested:

| LEVEL 3 | KNOWLEDGE AND COMPREHENSION | APPLICATION | ANALYSIS, SYNTHESIS AND EVALUATION |
|---|---|---|---|
| | 30% | 50% | 20% |

| MARK ALLOCATION PER QUESTION | | |
|---|---|---|
| Question 1: | Describe the fundamental of drive technology and related control methods and circuits | 20 |
| Question 2: | Describe and apply related electrical safety technology | 20 |
| Question 3: | Install and test electro-technical systems that employ electrical drives, switches and control technology | 30 |
| Question 4: | Design relay ladder logic related control circuits as used in electrical drive control technology | 20 |
| Question 5: | Maintain and commission installations that employ electrical drives, switches and control circuits | 10 |
| | **TOTAL** | **100** |