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NATIONAL CERTIFICATES (VOCATIONAL)

ASSESSMENT GUIDELINES

REFRIGERATION PRACTICE

NQF Level 3

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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 Refrigeration Principles, Refrigeration Practice and Refrigeration and Air Conditioning Processes 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: Refrigeration Practice* to prepare for and deliver Refrigeration Practice. 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 their 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 for students who experience barriers to learning be customised 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 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 • Class questions • Lecturer, student, parent discussions	• Assignments or tasks • Projects • Investigations or research • Case studies • Practical exercises • Demonstrations • Role-play • Interviews	• Examinations • Class tests • Practical examinations • Oral tests • Open-book tests
Assessment tools	• Observation sheets • Lecturer's notes • Comments	• Checklists • Rating scales • Rubrics	• Marks (e.g. %) • Rating scales (1-5)
Evidence	• Focus on individual students • Subjective evidence based on lecturer observations and impressions	**Open middle:** Students produce the same evidence but in different ways. **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. Use of 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 REFRIGERATION PRINCIPLES

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 Refrigeration Principles 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

Refrigeration Principles, Refrigeration Practice, and Refrigeration and Air Conditioning Processes, as is the case for all the other Vocational subjects, are 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 Refrigeration Practice Level 3:

NUMBER OF UNITS	ASSESSMENT	COVERAGE
3	Formal written tests	One or more completed topics
1	Internal written exams	All completed topics
5	Practical assessments	The related Subject Outcomes: 2.2 The installation of electrical cables, conductors and wire ways, completion of the paperwork and having the installation verified. 2.3 The maintenance of electrical cables, conductors and wire ways. 2.5 Explain the function of all components, select relevant components, connect components correctly, using the correct wire sizes, clean up in accordance with house-keeping standards, store all tools in accordance with workplace practices and dispose of all waste materials in accordance with work-site procedures. 3.5 The handling and storing of refrigeration oil to prevent it from becoming contaminated and unusable. 3.6 Obtaining an oil sample for analysis and reporting possible oil problems with a refrigeration system. 5.2 Transferring the prescribed amount of chemical from its container into a dosing cylinder without spillage and testing that the chemical is successfully put into the correct water circuit

ASSESSMENT OF REFRIGERATION PRACTICE

LEVEL 3

3 INTERNAL ASSESSMENT OF SUBJECT OUTCOMES IN REFRIGERATION PRACTICE LEVEL 3

Topic 1: Define and apply principles of thermodynamics

SUBJECT OUTCOME	
1.1 Define and apply the relationship between force, work, power and energy *Range: Watts, Joules*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The units of force, work, power and energy are correctly defined. • The relationship between the units of force, work, power and energy is explained. • Basic calculations involving force, work, power and energy are carried out.	• Define the units of force, work, power and energy. • Explain the relationship between the units of force, work, power and energy. • Carry out basic calculations involving force, work, power and energy.
ASSESSMENT TASKS OR ACTIVITIES	
• Class questions and case studies on the relationship between force work, power and energy.	

SUBJECT OUTCOME	
1.2 Define temperature and heat and explain the different forms of heat *Range: Kelvin, Celsius, Fahrenheit*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The difference between temperature and heat is explained and illustrated. • The difference between absolute and customary temperatures is explained. • Sensible heat and latent heat are defined and examples are given. • Name changes of the three phases of matter are explained • Basic calculations involving sensible and latent heat are carried out.	• Explain and illustrate the difference between temperature and heat. • Explain the difference between absolute and customary temperatures. • Define and give examples of sensible heat and latent heat. • Explain the name changes of the three phases of matter. • Carry out basic calculations involving sensible heat and latent heat.
ASSESSMENT TASKS OR ACTIVITIES	
• Lecturer's notes, observations and demonstrations on the difference between temperature and heat, between sensible and latent heat and between absolute and customary temperatures. • Tasks on calculations involving sensible and latent heat.	

SUBJECT OUTCOME	
1.3 Define pressure and explain the different types of pressure *Range: Absolute pressure, barometric pressure, gauge pressure and vacuum*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The terms absolute pressure, barometric pressure, gauge pressure and vacuum are defined and explained. • Approximate barometric pressures at various altitudes are explained. • Basic calculations involving absolute pressures, barometric pressures, gauge pressure and vacuum are carried out.	• Define and explain the terms absolute pressure, barometric pressure, gauge pressure and vacuum. • Explain the approximate barometric pressures at various altitudes. • Carry out basic calculations involving absolute pressures, barometric pressures, gauge pressures and vacuum.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment on the difference between absolute pressure, gauge pressure and vacuum, with basic calculations. • Practical exercises on approximate barometric pressures for various altitudes: sea level, 700, 1400, and 1700 metres, and solving problems involving different types of pressure at varying altitudes	

SUBJECT OUTCOME	
1.4 Define and apply the relationship between mass and volume *Range: density, specific volume, airflow and mass flow*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The terms density, specific volume, airflow and mass flow are defined and explained. • Calculations involving density, specific volume, airflow and mass flow are performed.	• Define and explain the terms density, specific volume, air flow and mass flow. • Perform basic calculations involving density, specific volume, air flow and mass flow.
ASSESSMENT TASKS OR ACTIVITIES	
• A task on the relationship between mass and volume	

Topic 2: Install and maintain electrical cables and single phase circuits

SUBJECT OUTCOME	
2.1 Prepare to install and terminate cables, conductors and wire ways *Range: Maximum 1 000 volt, three-phase, four-wire*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Job instructions are interpreted correctly, and drawings, plans and points of installation identified. • Correct equipment to be connected is identified and found. • Statutory requirements for a demarcated work area are explained. • Cables, conductors and wire ways are checked as specified, for suitability and functionality. • Required equipment and tools are prepared and checked for suitability and functionality. • Routing cables, conductors and wire ways are determined. • Required fixing materials are prepared for installing terminating cables and wire ways. • Obstacles to installation are identified and explained. • Required personal protective clothing and equipment are obtained and checked.	• Interpret job instructions correctly, and identify drawings and plans and the point of installation. • Identify and find correct equipment to be connected. • Interpret statutory requirements for a demarcated work area. • Check cables, conductors and wire ways as specified, for suitability and functionality. • Prepare and check equipment and tools required for suitability and functionality. • Determine routing cables, conductors and wire ways. • Prepare fixing materials required for installing terminating cables and wire ways. • Identify and explain obstacles to installation. • Obtain and check required personal protective clothing and equipment.
ASSESSMENT TASKS OR ACTIVITIES	
• A task with checklists and comments on the preparation for installation and termination of cables and conductors.	

SUBJECT OUTCOME	
2.2 Install electrical cables, conductors and wire ways *Range: Maximum 1 000 volt, three-phase-four-wire*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Cables and conductors are marked and terminated correctly according to drawing, work site procedures and manufacturer's specifications. • Cables and conductors are connected as per wiring diagram and work site instructions. • Terminations are checked and confirmed to be tight and secure according to manufacturer's specifications and work site procedures. • The work site is re-instated in accordance with work site procedures, house keeping standards and environmental and customer requirements. • The correct documentation is completed and submitted. • The reasons for verification, certification and testing of work in accordance with SANS 10142-1 by an accredited person are explained.	• Mark and terminate cables and conductors correctly according to drawing, work site procedures and manufacturer's specifications. • Connect cables and conductors as per wiring diagram and work site instructions. • Check that all terminations are tight and secure according to manufacturer's specifications and work site procedures. • Re-instate work site in accordance with work site procedures, house keeping standards and environmental and customer requirements. • Complete and submit the correct documentation. • Explain why work has to be verified, certified and tested by an accredited person in accordance with SANS 10142-1.
ASSESSMENT TASKS OR ACTIVITIES	
• Demonstrations and practical exercises on the installation of electrical cables, conductors and wire ways, completion of the paperwork and having the installation verified.	

SUBJECT OUTCOME	
2.3 Maintain electrical cables, conductors and wire ways *Range: Maximum 1 000 volt, three-phase, four-wire*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Safe isolation of equipment is verified as per safe working procedures. • Safety and security lockout system is verified in accordance with work site procedures. • Maintenance of cables, conductors and wire ways is done safely according to work site instructions to prevent breakdowns and loss of operation and/or service. • Damage and faults on cables and conductors that may endanger life are checked and reported. • Fixing cables, conductors and wire ways are checked and repaired. • Possible reasons for malfunctioning are identified and reported. • Documentation is completed and submitted.	• Verify safe isolation of equipment as per safe working procedures. • Verify safety and security lockout system in accordance with work site procedures. • Safely maintain cables, conductors and wire ways in accordance with work site instructions to prevent breakdowns and loss of operation and/or service. • Check and report damage and faults on cables and conductors that may endanger life. • Check and repair fixing cables, conductors and wire ways. • Identify and report possible reasons for malfunctioning. • Complete and submit documentation.
ASSESSMENT TASKS OR ACTIVITIES	
• Demonstrations, role-play and practical exercises on the maintenance of electrical cables, conductors and wire ways	

SUBJECT OUTCOME	
2.4 Identify switches, components and loads *Range: Protection devices: Circuit breakers, earth leakage relays, overload protection devices, and over/under voltage relays and typical control devices* *Electrical control panel accessories: Door interlocked isolators (plain and fused) current transformers, running hour meters, auto-off-manual selector switches,* *Typical circuits: Circuits for 2, 4, 6 and 8 pole three-phase, single speed induction motors.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Symbols for switching devices are identified and drawn as per range statement. • Symbols for the various types of protective devices are identified and drawn. • Symbols for the various types of single-phase motors and accessories are identified are drawn. • Symbols for the various types of control instruments are identified and drawn. • Symbols for the various types of electrical control panel accessories are identified and drawn • Resistive and inductive loads are defined and compared.	• Identify and draw symbols for switching devices as per range statement. • Identify and draw symbols for the various types of protective devices. • Identify and draw symbols for the various types of single-phase motors and accessories. • Identify and draw symbols for the various types of control instruments. • Identify and draw symbols for the various types of electrical control panel accessories. • Define and compare resistive and inductive loads.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment and observation sheets to identify and draw symbols for switching devices, protective devices, single-phase motors and accessories, control instruments and electrical control panel accessories. • A project on the comparison of resistive and inductive loads.	

SUBJECT OUTCOME	
2.5 Sketch and interpret basic single-phase circuit diagrams and construct circuits *Range: Protection devices: Circuit breakers, earth leakage relays, overload protection devices, and over/under voltage relays and typical control devices* *Electrical control panel accessories: Door interlocked isolators (plain and fused), current transformers, running hour meters, Auto-off-manual selector switches,* *Typical circuits: Circuits for 2, 4, 6 and 8 pole three-phase, single speed induction motors.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Basic single-phase circuit diagrams are sketched. • Different circuits are constructed as per range statement. • Selection of relevant components is explained. • The need to connect the suitable components correctly according to the diagram is explained. • The need for all wiring to be done in accordance with work site instructions is explained. • The reason for use of correct wire sizes is explained. • The manner of connecting the circuit correctly to the power supply is explained. • Correct operation of the circuit as intended is ensured. • Correct tools are used appropriately.	• Sketch basic single-phase circuit diagrams. • Construct different circuits as per range statement. • Explain selection of the relevant components. • Explain why it is necessary to connect the suitable components correctly according to the diagram. • Explain why all wiring must be done in accordance with work site instructions. • Explain why the correct wire sizes must be used. • Explain how to connect the circuit correctly to the power supply. • Make sure the operation of the circuit is correct as intended. • Use the correct tools appropriately.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment to sketch a typical circuit and check lists to interpret circuit diagrams. • Practical exercises to explain the function of all components, to select relevant components, to connect components correctly, using the correct wire sizes, to clean up in accordance with house-keeping standards, to store all tools in accordance with workplace practices and to dispose of all waste materials in accordance with work-site procedures.	

Topic 3: Explain and apply fault finding, dismantling, re-assembly and oil analysis

SUBJECT OUTCOME	
3.1 Prepare for fault finding of a plant *Range: Single phase refrigeration plant*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Appropriate electrical and mechanical testing tools are listed. • The importance of availability of the plant operating and maintenance instructions is explained. • The importance of knowing the exact location of the plant is explained. • The need for inspection of service records for the plant prior to work is explained. • The need for discussing possible reasons for plant stoppage with the user/operator is explained. • Possible faults causing plant failure are explained.	• List the appropriate electrical and mechanical testing tools. • Explain why it is important that the operating and maintenance instructions for the plant are available. • Explain why knowing the exact location of the plant is important. • Explain why service records for the plant should be inspected prior to work. • Explain why it is necessary for all possible reasons for plant stoppage to be discussed with the user/operator. • Explain possible faults causing plant failure.
ASSESSMENT TASKS OR ACTIVITIES	
• Demonstrations and role-play to give a talk on fault finding preparation techniques	

SUBJECT OUTCOME	
3.2 Establish possible electric faults causing plant stoppage *Range: Single phase refrigeration plant*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• All possible causes of electrical faults are investigated, diagnosed and explained. • The consequences of faulty selection of switching or protective devices are explained. • The consequences of wrong power supply and faulty setting of overloads are explained.	• Explain why all possible causes of electrical faults are investigated and diagnosed. • Explain the consequences of faulty selection of switching or protective devices. • Explain the consequences of wrong power supply and faulty setting of overloads.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment on electrical fault finding issues and techniques	

SUBJECT OUTCOME	
3.3 Establish possible control faults causing plant stoppage *Range: Single phase refrigeration plant*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• All control instruments are checked for faulty settings and compared with stipulated or normally acceptable settings required for correct and safe operation. • Control settings are adjusted according to specified parameters or as required for correct and safe operation. • Operation of the defrost system is checked. • The appropriate corrective action is explained. • Consequences of faulty settings on controls are explained. • The reasons for methodical fault finding and taking appropriate action are given.	• Check all control instruments for faulty settings and compare with stipulated or normally acceptable settings required for correct and safe operations. • Adjust control settings according to specified parameters or as required for correct and safe operation. • Check operation of the defrost system. • Explain the appropriate corrective action. • Explain the consequences of faulty settings on controls. • Explain why fault finding is done in a methodical manner and appropriate action taken.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment on fault finding techniques highlighting the necessity of knowing the function of the plant and all its components. • A practical exercise to submit a problem scenario with possible symptoms, faults and solutions	

SUBJECT OUTCOME	
3.4 Establish possible mechanical faults causing plant stoppage *Range: Single phase refrigeration plant*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Mechanical faults are listed and established from plant operating conditions. • Possible mechanical faults are listed and investigated to establish a problem. • Appropriate corrective action is listed after diagnosing a problem.	• List and establish mechanical faults from plant operating conditions. • List and investigate possible mechanical faults to establish a problem. • List appropriate corrective action after diagnosing the problem.
ASSESSMENT TASKS OR ACTIVITIES	
• A task on an assessment of an operating plant, its problems and an explanation of how to establish and address these problems.	

SUBJECT OUTCOME	
3.5 Identify refrigeration oils *Range: Synthetic and mineral oils.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Different types of refrigeration oil are listed and their applications explained. • Containers of different oils are identified correctly. • The importance of using the correct oil is explained. • The consequences of using incorrect oil are explained. • Precautions to be taken when handling and storing refrigeration oil are listed and the prevention of contamination is explained.	• List the different types of refrigeration oil and explain their applications • Identify containers of different oils correctly. • Explain the importance of using the correct oil. • Explain the consequences of using incorrect oil. • List the precautions to be taken when handling and storing refrigeration oil and explain the prevention of contamination.
ASSESSMENT TASKS OR ACTIVITIES	
• An investigation or research project to list refrigeration oils, their applications and the consequences of using incorrect oils. • Demonstrations and practical exercises on the handling and storing of refrigeration oil to prevent it from becoming contaminated and unusable.	

SUBJECT OUTCOME	
3.6 Assess and report on the general condition of the oil used in a refrigeration system *Range: Observing the oil in the compressor sump sight glass and testing a sample of the oil.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The reasons for the lack of or the presence of foam in oil providing an indication of the condition of the system and whether it is correct and in accordance with industry norms are explained. • The implications of the observed oil level in the oil sight glass are explained in terms of its acceptability for the operating conditions and capacity. • The method of obtaining an oil sample is explained in line with the requirements of the testing laboratory and good refrigeration practice. • The indications of colour and smell of oil with respect to establishing whether it is satisfactory and in accordance with oil and compressor manufacturers' standards are explained. • The methods of avoiding external contamination of an oil sample are listed and explained.	• Explain why the lack or presence of foam in oil is an indication of the condition of the system and that it is correct and in accordance with industry norms. • Explain the implications of the observed level in the oil sight glass for the operating conditions and capacity. • Explain the method of obtaining an oil sample that is in line with the requirements of the testing laboratory and good refrigeration practice. • Explain how the colour and smell of the oil observed is a means of establishing whether it is satisfactory or not and is in accordance with oil and compressor manufacturers' standards. • List and explain the methods used to avoid external contamination of an oil sample.

ASSESSMENT TASKS OR ACTIVITIES
• Observations, case studies and practical exercises in obtaining an oil sample for analysis and reporting possible oil problems within a refrigeration system

SUBJECT OUTCOME	
3.7 Explain and carry out dismantling and assembly activities *Range: Refrigeration compressors, electric motors, pumps, fans and components used in air conditioning, refrigeration and ventilation plants.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Reasons for dismantling and assembly are listed. • The work sequence and techniques of dismantling and assembly are explained and the importance of the various sequences and techniques listed. • Functions of the various equipment components are listed • The common defects for which equipment parts should be examined are explained. • Work activities are planned to maintain productive work output and to ensure compliance with given work instructions. • Possible long-term damage to equipment, components and parts are explained, as well as cost implications resulting from poor work techniques. • The reasons for safe handling of tools, equipment and instrumentation, in accordance with their intended use and/or manufacturer's specification during dismantling and assembly are explained. • Safety procedures to prevent harm to oneself and others and to prevent damage to equipment are explained. • The procedures to ensure that dismantling and assembly is carried out according to manufacturer's specifications are listed. • Testing and commissioning procedures are listed on completion of work.	• List reasons for dismantling and assembly. • Explain the work sequence and techniques of dismantling and assembly and list the importance of the various sequences and techniques. • List the functions of the various equipment components. • Explain the common defects for which equipment parts should be examined. • Plan work activities to maintain productive work output and ensure compliance with given work instructions. • Explain possible long term damage to equipment, components and parts, as well as cost implications resulting from poor work techniques. • Explain why safe handling of tools, equipment and instrumentation must be in accordance with their intended use and/or manufacturer's specification during dismantling and assembly. • Explain the safety procedures to prevent harm to oneself and others and to prevent damage to equipment. • List the procedures to ensure that dismantling and assembly is carried out according to manufacturer's specifications. • List testing and commissioning procedures on completion of work.
ASSESSMENT TASKS OR ACTIVITIES	
• A project and rubrics to produce a feasible plan to dismantle and assemble equipment	

Topic 4: Explain and apply legal requirements for Group 1 refrigerants, layouts, drawings, sketches and technical specifications

SUBJECT OUTCOME	
4.1 Describe the objectives of SANS 10147 and the requirements for personal protection equipment *Range: Refrigeration systems, containing Group 1 refrigerant, including plants associated with air-conditioning systems, other than those listed under clause 1 (Scope) of SANS 10147 (SABS 0147).*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The objectives of SANS 10147 are stated. • The refrigeration equipment not subject to SANS 10147 is listed. • The refrigerant groups dealt with in SANS 10147 are listed and defined. • The terms 'pressure relief device', 'pressure relief valve', 'fusible plug', 'bursting disc', 'pressure limiting device', 'changeover device', 'packaged unit' and 'competent person' are defined. • The requirements to provide respirators and self-contained breathing apparatus hen the amount of refrigerant in the plant exceeds 1000 kg are listed. • The requirements regarding inspection, maintenance and storage of respirators and breathing apparatuses are stated.	• State the objective of SANS 10147. • List the refrigerant equipment not subject to SANS 10147. • List and define the refrigerant groups dealt with in SANS 10147. • State the definitions of 'pressure relief device', 'pressure relief valve', 'fusible plug', 'bursting disc', 'pressure limiting device', 'changeover device', 'packaged unit', and 'competent person'. • List the requirements to provide respirators and self-contained breathing apparatus when the amount of refrigerant contained in a plant exceeds 1 000 kg. • State the requirements regarding inspection, maintenance and storage of respirators and breathing apparatus.
ASSESSMENT TASKS OR ACTIVITIES	
• An investigation or research project to illustrate an understanding of the SANS 10147 objectives and requirements for personal protection equipment	

SUBJECT OUTCOME	
4.2 List and describe the regulations regarding machinery areas, plant rooms and cold rooms Range: *Refrigeration systems, containing group 1 refrigerant, including plants associated with air-conditioning systems, other than those listed under clause 1 (Scope) of SANS 10147 (SABS 0147).* *Adhere to the standards of SANS 10147 (SABS 0147) when handling Group 1 refrigerants to prevent situations that could result in loss of life, injury to persons or damage to refrigeration plants operating with a Group 1 refrigerant as required according to by the OHS Act and the Mines Health & Safety Act.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The requirements for ventilating plant rooms are explained. • The special requirements with which plant rooms must comply are explained. • The requirements regarding refrigerant detectors are explained. • The safety provisions incorporated in the construction of refrigerated chambers are listed. • The requirements for installations where the power input to the compressor(s) exceeds 20 kW are listed. • The arrangements and operating procedures regarding emergency exits and personnel working inside cold rooms are listed.	• Explain the requirements for ventilating plant rooms. • Explain the special requirements with which plant rooms must comply. • Explain the requirements regarding refrigerant detectors. • List the safety provisions incorporated in the construction of refrigerated chambers. • List the requirements for installations where the power input to the compressor(s) exceeds 20 kW. • List the arrangements and operating procedures regarding emergency exits and personnel working inside cold rooms.
ASSESSMENT TASKS OR ACTIVITIES	
• Case studies and an open-book test to show an understanding of the regulations regarding machinery areas, plant rooms and cold rooms from SANS 10147	

SUBJECT OUTCOME	
4.3 List and describe the operation, maintenance and provision of servicing of refrigerating systems *Range: Refrigeration systems, containing Group 1 refrigerant, including plants associated with air-conditioning systems, other than those listed under clause 1 (Scope) of SANS 10147 (SABS 0147).* *Adhere to the standards of SANS 10147 (SABS 0147) when handling Group 1 refrigerants to prevent situations that could result in loss of life, injury to persons or damage to refrigeration plants operating with a Group 1 refrigerant as required according to by the OHS Act and the Mines Health & Safety Act.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The regulations regarding the personnel responsible for operating, servicing and maintaining a refrigeration plant are listed and described. • The regulations regarding instructions to be placed inside the plant room and required instruction manuals are listed and described. • The regulations regarding work to be carried out inside refrigerated chambers are listed and described. • The regulations regarding the use of refrigerant containers for charging and discharging refrigerants are listed and described. • The regulations regarding the storage of refrigerant in a plant room are listed and described. • The regulations regarding the replacement of metal signs after substitution of refrigerant are listed and described.	• List and describe the regulations regarding the personnel responsible for operating, servicing and maintaining a refrigeration plant. • List and describe the regulations regarding instructions to be placed inside the plant room and instruction manuals required. • List and describe the regulations regarding work to be carried out inside refrigerated chambers. • List and describe the regulations regarding the use of refrigerant containers for charging and discharging refrigerants. • List and describe the regulations regarding the storage of refrigerant in a plant room. • List and describe the regulations regarding the replacement of metal signs after a refrigerant has been substituted.
ASSESSMENT TASKS OR ACTIVITIES	
• Case studies and an open-book test to show understanding of the operation, maintenance and provision of servicing refrigerating systems from SANS 10147	

SUBJECT OUTCOME	
4.4 List and describe the regulations regarding field tests on refrigerating systems and the duties of responsible persons as detailed in SANS 10147 *Range: to advise the owner of the plant of any cases where the installation does not comply with the requirements of the standard and to recommend that the necessary changes be made in order to ensure compliance by generating a report, detailing all the applicable non conformance items and indicating recommendations of necessary changes to be made in order to ensure compliance*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The regulations regarding the pressure testing of refrigerating systems are listed. • The duty of any person operating, maintaining or repairing refrigeration equipment as detailed in SANS 10147 is stated.	• List and describe the regulations regarding the pressure testing of refrigerating systems. • State the duty of any person operating, maintaining or repairing refrigeration equipment.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment to show understanding of the regulations regarding field tests of refrigerating systems and the duties of responsible persons with respect to SANS 10147	

SUBJECT OUTCOME	
4.5 Explain the purpose of technical drawings and specifications *Range: Circuit and block diagrams. Air-conditioning, refrigeration and ventilation, architectural and structural layout drawings*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The purpose of engineering drawings and specifications is explained as a means of communicating technical information in a given example. • Knowledge of the technical services provided by the drawing office is illustrated. • The need for component, sub-assembly and layout drawings is explained. • The materials, tools and equipment required and the sequence of operation to manufacture, install, dismantle, overhaul and assemble equipment are explained from a drawing. • The need for main items of supplementary information supplied is explained with technical drawings to illustrate required material, finishes and tolerances.	• Explain the purpose of engineering drawings and specifications as a means of communicating technical information in a given example. • Illustrate knowledge of the technical services provided by the drawing office. • Explain the need for component, sub-assembly and layout drawings. • Explain from a drawing the materials, tools and equipment required and the sequence of operation to manufacture, install, dismantle, overhaul and assemble equipment. • Explain the need for main items of supplementary information supplied with technical drawings to illustrate required material, finishes and tolerances.
ASSESSMENT TASKS OR ACTIVITIES	
• Observations, role-play and class questions on the need for drawings to be at hand before any repair or maintenance work is undertaken.	

SUBJECT OUTCOME	
4.6 Explain the methods of communicating technical information *Range: Circuit and block diagrams. Air-conditioning, refrigeration and ventilation, architectural and structural layout drawings.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Orthographic, isometric and oblique methods of representing technical drawings for engineering components and equipment are explained • The need for construction drawings is explained with regard to architectural drawings, structural engineering drawings, building services drawings, electrical and mechanical equipment lay out. • The importance of understanding drawings drawn to different scales or units is explained.	• Explain orthographic, isometric and oblique methods of representing technical drawings for engineering components and equipment. • Explain the need for construction drawings with regard to architectural drawings, structural engineering drawings, building services drawings, electrical and mechanical equipment layout.Explain the importance of understanding drawings drawn to different scales or units.
ASSESSMENT TASKS OR ACTIVITIES	
• Case studies and rubrics to explain why there is such a large variety of drawings applicable to engineering processes	

Topic 5: Explain and demonstrate water treatment systems

SUBJECT OUTCOME	
5.1 Explain the reasons for water treatment *Range: The commonly applied chemicals for treatment of chilled water, condenser water and hot water systems as used in air-conditioning and refrigeration plants.* *Hot water, condenser water and chilled water circuits.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Factors that reduce heat exchange are explained. • Effects of heating water on the heat exchanger are listed. • The effect of non-treatment of water is explained. • The need for taking precautions against samples becoming contaminated by external contaminants is explained. • The means of ensuring that no water other than the amount required for the sample is lost from the circuit is explained.	• Explain the factors that reduce heat exchange. • List the effects of heating water on the heat exchanger. • Explain the effect of non-treatment of water. • Explain the need for taking precautions against samples becoming contaminated by external contaminants. • Explain how to ensure that no water other than the amount required for the sample is lost from the circuit.
ASSESSMENT TASKS OR ACTIVITIES	
• A project to explain why water treatment is important in refrigeration and air conditioning systems	

SUBJECT OUTCOME	
5.2. Explain and demonstrate water treatment application *Range: Relevant safety precautions, dosing procedures, and personal protective equipment (PPE) for handling biocides and other chemicals used in treating water*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Safe handling procedures are explained for biocides and each of the other specified chemicals to ensure they conform to manufacturer's requirements for each product. • The need for accurate dosing is explained. • Correct identification of chemicals is explained. • Ways of transferring the prescribed amount of chemical from its container into a dosing cylinder without spillage are explained and demonstrated. Tests are done to confirm that the chemical has successfully been put into the correct water circuit.	• Explain safe handling procedures for biocides and each of the other specified chemicals to ensure conformance to manufacturer's requirements for each product. • Explain the need for accurate dosing. • Explain how chemicals are correctly identified. • Explain and demonstrate how the prescribed amount of chemical is transferred from its container into a dosing cylinder without spillage. • Test that the chemical is successfully put into the correct water circuit.
ASSESSMENT TASKS OR ACTIVITIES	
• Observation and assignments to explain the need to monitor the water treatment process. • A practical exercise on transferring the prescribed amount of chemical from its container into a dosing cylinder without spillage, and testing that the chemical has successfully been put into the correct water circuit.	

4 SPECIFICATIONS FOR EXTERNAL ASSESSMENT IN REFRIGERATION PRACTICE - 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 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:

	KNOWLEDGE AND COMPREHENSION	APPLICATION	ANALYSIS, SYNTHESIS AND EVALUATION
LEVEL 3	40%	40%	20%

MARK ALLOCATION PER QUESTION		
All questions are compulsory		
Question 1:	Define and apply principles of thermodynamics	25%
Question 2:	Install and maintain electrical cables and single phase circuits	25%
Question 3:	Explain and apply fault finding, dismantling, re-assembly and oil analysis	25%
Question 4:	Explain and apply legal requirements for group 1 refrigerants, layouts, drawings, sketches and technical specifications	20%
Question 5:	Explain and demonstrate water treatment systems	5%
	TOTAL	**100**