higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATES (VOCATIONAL)

ASSESSMENT GUIDELINES

ELECTRICAL PRINCIPLES AND PRACTICE

NQF LEVEL 4

IMPLEMENTATION: JANUARY 2015

ELECTRICAL PRINCIPLES AND PRACTICE – LEVEL 4
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 Electrical Principles and Practice Level 4 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 internal and external subject assessment. The lecturer must use this document with the *Subject Guidelines: Electrical Principles and Practice Level 4* to prepare for and deliver Electrical Principles and 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 resource 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 in order 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 components of the delivery system.

- ***Portability***

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

- ***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 assessment or if a student possesses the capabilities specified in the outcomes statement.

- ***Validity of assessments***

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

  - clearly stating the outcome to be assessed;
  - selecting 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 ensure that assessment practices are consistent so that the same result or judgement 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 students' work with that of other students, 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 (ICASS) 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 or a set of written paper(s) set to the requirements of the Subject Learning Outcomes. The Department of Higher Education and Training (DHET) 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 students' 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 ISAT 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 ISAT.
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 Higher Education and Training, 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 that proper procedures are followed;
- ensures that 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 to 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 ICASS must be re-submitted with each examination enrolment for which it constitutes a component.

5 ASSESSOR REQUIREMENTS

Assessors must be subject specialists and competent assessors.

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 that students bring to the classroom. This knowledge assists lecturers in planning 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 for making 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 achievement in 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 (1-7)
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 7) 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 is 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 are used, namely holistic and analytical.

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 as evaluation of specific tasks. However, marks should be awarded against rubrics and should not simply be a total of ticks for right answers. Rubrics should explain the competence level descriptors for the skills, knowledge, values and attitudes 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 it 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 record observations of 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.

ASSESSMENT OF ELECTRICAL PRINCIPLES AND PRACTICE

NQF LEVEL 4

SECTION C: ASSESSMENT IN ELECTRICAL PRINCIPLES AND PRACTICE

1 ASSESSMENT SCHEDULE AND REQUIREMENTS

Internal and external assessments are conducted and the results of both contribute to the final mark of a student in the subject.

The internal continuous assessment (ICASS) mark accounts for 50 percent and the external mark for 50 percent of the final mark. A student needs a minimum final mark of 50 percent to achieve a pass in the subject.

1.1 Internal assessment

Lecturers must compile a detailed assessment plan and assessment schedule of internal assessments to be undertaken during the year in the subject (e.g. date, assessment task or activity, rating code/marks allocated, assessor, moderator).

All internal assessments are then conducted according to the plan and schedule using appropriate assessment instruments and tools for each assessment task (e.g. tests, assignments, practical tasks/projects and memoranda, rubrics, checklists).

The marks allocated to the minimum number of both practical and written assessment tasks conducted during the internal continuous assessment (ICASS) are kept and recorded in the Portfolio of Evidence (PoE) which is subject to internal and external moderation.

A year mark out of 100 is calculated from the ICASS marks contained in the PoE and submitted to DHET on the due date towards the end of the year.

The following internal assessment units **GUIDE** the internal assessment of *Electrical Principles and Practice NQF Level 4.*

TASKS	**Time-frame**	**Type of assessment activity**	**Minimum time and proposed mark allocation** (*can be increased but not reduced)	**Scope of assessment**	**% contribution to the year mark**
				Do not confuse the weightings of topics in the Subject Guidelines with the % contribution to the year mark	
1	Term 1	Test	1 hour (50 marks)	Topics completed in Term 1	10
2	Term 1	Practical Assessment/ Assignment	Determined by the scope and nature of the task	One or more of the topics completed as an assignment	25

3	Term 2	Practical Assessment/ Assignment	Determined by the scope and nature of the task	One or more of the topics completed as an assignment	25
4	Term 2	Test*	1 hour (50 marks)	Topics completed in Term 1 and 2	10
5	Term 3	Internal Examination*	*As per external examinations* (P1 & P2 where applicable)	Topics completed to date (P1 =15 & P2=15, where applicable)	30
				TOTAL	**100**

Specifications for internal assessment may change over time. A separate internal assessment guideline document '*Guidelines for the Implementation of Internal Continuous Assessment (ICASS) in the NC(V) qualifications at FET Colleges'* has been developed, and is updated and available on the Departmental website. The conduct and administration of internal assessments must always comply with specifications contained in the most current version of the guideline document

2 RECORDING AND REPORTING

Electrical Principles and Practice 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 planned and scheduled assessment should be recorded in the lecturer's Portfolio of Assessment (PoA) for each subject. The minimum requirements for the **Lecturer's Portfolio of Assessment** should be as follows:

- Lecturer information
- A contents page
- Subject and Assessment Guidelines
- A subject Year Plan /Work Scheme/Pace Setter
- A subject assessment plan

- Instrument(s) (tests, assignments, practical) and tools (memoranda, rubrics, checklists) for each assessment task
- A completed pre-moderation checklist for each of the ICASS tasks and their accompanying assessment tools
- A completed post-moderation checklist once the task has been administered and assessed
- Subject record sheets per level/class reflecting the marks achieved by students in the ICASS tasks completed
- Evidence of review – diagnostic and statistical analysis, including notes on improvement of the task for future use.

The college could standardise these documents.

The minimum requirements for the **student's Portfolio of Evidence (PoE)** should be as follows:

- Student information/identification
- Declaration of authenticity form – duly completed (signed and dated)
- A contents page/list of content (for accessibility)
- A subject assessment schedule
- The evidence of marked assessment tasks and feedback according to the assessment schedule
- A summary record of results showing all the marks achieved per assessment for the subject
- Evidence of moderation (only where applicable for student's whose tasks were moderated)

Where tasks cannot be contained as evidence in the Portfolio of Evidence (PoE), their exact location must be recorded and they must be readily available for moderation purposes.

3 INTERNAL ASSESSMENT OF SUBJECT OUTCOMES IN ELECTRICAL PRINCIPLES AND PRACTICE - LEVEL 4

Topic 1: Fundamentals of Electricity

SUBJECT OUTCOME	
1.1 Explain DC Networks	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The basic terms commonly used within an electrical network are defined *Range: Network, network element, branch, junction point, node and loop*	• Define basic terms commonly used within an electrical network
• The classification of electrical networks is listed and explained *Range: linear, non-linear, active and passive networks*	• List and explain the classification of electrical networks

• Unknown voltages, currents and resistance in a circuit are calculated *Range: series, parallel and series-parallel*	• Calculate unknown voltages, currents and resistance in a circuit
• Unknown currents and voltages in a circuit are calculated using Kirchhoff's laws *Range: Max with two batteries and a generator*	• State and use Kirchhoff's laws to determine unknown currents and voltages in a circuit

ASSESSMENT TASKS OR ACTIVITIES

Theoretical assessment

- Assess the student on the achievement of the learning outcomes listed here.
- Given a circuit, students use loops to obtain equations which are solved to determine unknown currents, for example current supplied by generator, current through battery A and B.

Practical assessment

- Student builds circuits on breadboard, the electrical quantities measured and compared with calculated values using Ohm's and Kirchhoff's laws.

SUBJECT OUTCOME

1.2 Explain measuring instruments

ASSESSMENT STANDARD	LEARNING OUTCOME
• The manner in which measuring instruments are inserted into circuits is sketched and explained *Range: Voltmeters, ammeters, ohmmeters, wattmeter (single phase), frequency meters, insulation resistance testers, clamp on ammeter and instrument transformers*	• Sketch and explain how measuring instruments are inserted into circuits
• The value of series and shunt resistors required to extend the range of voltmeters and ammeters in a circuit is calculated	• Calculate the value of series and shunt resistors required to extend the range of voltmeters and ammeters in a circuit
• The two different methods of connecting a voltmeter and ammeter in a circuit are listed and explained	• List and explain the two different methods of connecting a voltmeter and ammeter in a circuit *Range: short and long shunt*
• The calculation of the value of an unknown resistance is explained using the Wheatstone bridge	• Explain using the Wheatstone bridge how the value of an unknown resistance is calculated
• Practical applications of the Wheatstone bridge are listed and explained	• List and explain the practical applications of the Wheatstone bridge
• Errors in measurement are calculated *Range: Absolute error and percentage relative error*	• Calculate errors in measurement

ASSESSMENT TASKS OR ACTIVITIES
Theoretical assessment • Assess the student on the achievement of the learning outcomes listed here. Practical assessment • Student must be able to connect the measuring instruments stated in the range • Demonstrate the two different methods of connecting a voltmeter and ammeter in a circuit • Build a Wheatstone bridge

SUBJECT OUTCOME	
1.3 Explain alternating voltages and currents	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Terms such as cycle, period time and frequency of a waveform are defined	• Define cycle, period time and frequency of a waveform
• Periodic time and frequency are calculated	• Perform calculations for periodic time and frequency
• Terms such as instantaneous, peak, average and r.m.s values, form and peak factors for a sine wave are defined	• Define instantaneous, peak, average and r.m.s values, form and peak factors for a sine wave
• Calculations are performed using the general sinusoidal equation	• Perform calculations using the general sinusoidal equation $v = V_m \sin(\omega t \pm \phi)$
ASSESSMENT TASKS OR ACTIVITIES	
Theoretical assessment Assess the student on the achievement of the learning outcomes listed here. Calculations include, for example • An alternating voltage is represented by $v = 50 \sin(200\pi t - 0{,}75)$ volts. Calculate the amplitude, peak to peak value, the r.m.s value, the periodic time, the frequency and phase angle in degrees and minutes. Practical assessment • Student does practical on oscilloscope to display voltages	

SUBJECT OUTCOME	
1.4 Explain the concepts of series and parallel AC circuits	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Phasor diagrams of current and voltage waveforms for AC circuits are drawn *Range: purely resistive, inductive and capacitive.*	• Draw phasor diagrams of current and voltage waveforms for AC circuits

• The concepts of inductive and capacitive reactance are explained	• Explain the concepts of inductive and capacitive reactance
• Calculations for series and parallel RL, RC and RLC circuit (excluding resonance) are performed	• Perform calculations for series RL, RC and RLC circuit (excluding resonance) • Perform calculations for parallel RL, RC and RLC circuit (excluding resonance)
• Power in an AC circuit is calculated	• Calculate power in an AC circuit
• True, apparent, reactive power and power factor are calculated	• Calculate true, apparent, reactive power and power factor
• The importance of power factor is explained	• Explain the importance of power factor

ASSESSMENT TASKS OR ACTIVITIES

Theoretical assessment

- Assess the student on the achievement of the learning outcomes listed here.
- The effect of change of frequency on current and voltage in a RC series circuit is explained
- Show how impedance and phase angle vary with frequency in a parallel RC circuit.
- Voltage and current waveforms are compared in RL circuit
- The effect of change of frequency on current and voltage in a series RL circuit is discussed
- Student does calculations on RC series and parallel
- Students calculate impedance, reactance, voltage, current, phase angle; and a phasor diagram is drawn for the circuit.
- RL series and parallel: students perform calculations to determine impedance, reactance, voltage, current, phase angle; and phasor diagram and impedance triangle of the circuit are drawn
- RLC series and parallel: determine current, voltage, impedance, phase angle; and draw phasor diagrams for an RLC circuit

Practical assessment

- Practical examination of the behaviour of series and parallel RC, RL and RLC circuits

Topic 2: Generation and supply of electricity

SUBJECT OUTCOME	
2.1 Explain the principles behind the generation and supply of electricity	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The generation of single-phase and three-phase A.C supply is explained with sketches	• Explain with the aid of sketches how single-phase and three-phase A.C. supply is generated
• The advantages of 3-phase distribution and disadvantages of single phase distribution are explained	• Explain advantages of 3-phase distribution • Explain disadvantages of single phase distribution

• The layout of a typical electrical supply from the generating plant to the customer is sketched and explained, showing transformer applications and typical operating voltages	• Sketch and explain the layout of a typical electrical supply from the generating plant to the customer, showing transformer applications and typical operating voltages
• The effect of voltage on transmission efficiency is explained	• Discuss the effect of voltage on transmission efficiency
• The advantages of transmitting power over the transmission lines at high voltages are listed	• List the advantages of transmitting power over the transmission lines at high voltages
• The resources that are mainly used for generating electrical energy are listed and explained *Range: Thermal, hydroelectric and nuclear*	• List and explain resources that are mainly used for generating electrical energy
• Radial and ring distribution networks are differentiated	• Differentiate between radial and ring distribution networks
• Materials and components used in overhead transmission lines are sketched and explained *Range: max. 11000V; poles, struts, ties, pin-, strain- and suspension-insulators, steel cored conductors, lightning arrestors, transformers, fuses and switchgear.*	• Sketch and explain materials and components used in overhead transmission lines
ASSESSMENT TASKS OR ACTIVITIES	
Theoretical assessment: • Assess the student on the achievement of the learning outcomes listed. Practical assessment • Student identifies different materials and components used in overhead transmission lines	

SUBJECT OUTCOME	
2.2 Explain three-phase systems	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Star and delta connections are explained	• Explain star and delta connections
• Line voltage / current and phase voltage / current in star and delta connections are calculated	• Calculate line voltage / current and phase voltage / current in star and delta connections
• The phasor diagram for a balanced star and delta connected load is sketched	• Sketch the phasor diagram for a balanced star and delta connected load
• Power in a three-phase system is calculated	• Calculate power in a three-phase system
• Measurement of power in a three-phase system is explained by using one, two and three wattmeter methods	• Explain how power is measured in a three-phase system by using one, two and three wattmeter methods

• Star and delta connections are compared	• Compare star and delta connections
ASSESSMENT TASKS OR ACTIVITIES	
Theoretical assessment • Assess students on the achievement of the learning outcomes Practical assessment • Student does practical to measure electrical quantities in star and delta connections	

Topic 3: Earthing practices

SUBJECT OUTCOME	
3.1 Explain the earthing of electrical appliances, installations and low-voltage (LV) distribution systems.	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• Terms used for earthing are defined according to current regulations and standards *Range: earth, earthed, earthing, earth electrode, earth fault current, earth electrode, earth leakage current, fault, fault current, earth fault current, earth continuity conductor and consumer earth terminal*	• Define terms used for earthing according to current regulations and standards
• The functions of earthing are listed	• List the functions of earthing
• Materials and types of earth electrodes that can be used are listed	• List materials and types of earth electrodes that can be used
• The means of achieving earthing in electrical appliances and domestic installation is explained	• Explain how earthing is achieved in electrical appliances and domestic installation
• The aim of bonding and the requirements for a bonding conductor are explained	• Explain the aim of bonding and the requirements for a bonding conductor
• The parts to be bonded in a domestic installation are listed	• List the parts to be bonded in a domestic installation
• Tests to ensure that an installation conforms to earthing regulations are performed *Range: Continuity of bonding, resistance of earth continuity conductor, earth fault loop impedance tests*	• Perform tests to ensure that an installation conforms to earthing regulations
• The reasons for earthing the neutral of a low-voltage (LV) system are listed	• List the reasons for earthing the neutral of a low-voltage (LV) system.
• TN-C-S and TN-S systems earthing is explained with sketches	• Explain with the aid of a sketch TN-C-S and TN-S systems earthing

• The operation of earth core leakage relays are explained with the aid of sketches *Range: single and three-phase*	• Explain, with the aid of sketches, the operation of earth core leakage relays
• The testing of earth leakage relays is explained	• Explain how earth leakage relays are tested
ASSESSMENT TASKS OR ACTIVITIES	
Theoretical assessment • Assess the student on the achievement of the learning outcomes listed. Practical assessment • Student identifies earthing practices in electrical appliances and domestic installations • Students practically demonstrate how bonding is performed • Students perform tests according to current regulations and standards, and record results • Earth leakage relays are connected in a distribution board, and tested for compliance • Students design an earth leakage tester as a project.	

Topic 4: Transformers

SUBJECT OUTCOME	
4.1 Explain single-phase transformers	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The operation and construction of a basic transformer is explained	• Explain the operation and construction of a basic transformer
• Shell and core type transformers are distinguished	• Distinguish between shell and core type transformers
• Basic calculations for transformers are performed *Range: transformer turns ratio, current ratio, voltage ratio and rating of a transformer*	• Perform basic calculations for transformers
• Losses in a transformer are explained *Range: Copper and iron (eddy current and hysteresis) losses*	• Explain losses in a transformer
• Changes of efficiency with different power factors are illustrated graphically	• Illustrate graphically changes of efficiency with different power factors
• The conditions for maximum efficiency of a transformer are discussed	• Discuss the conditions for maximum efficiency of a transformer
• Transformer efficiency at full load is calculated	• Calculate transformer efficiency at full load
• The emf equation of a transformer is explained and used	• Explain and use the emf equation of a transformer

• The phasor diagram on no-load is drawn and used	• Draw and use the phasor diagram on no-load
• The two types of tests performed on a transformer are listed and explained *Range: open circuit (no-load) and short circuit (impedance) tests*	• List and explain the two types of tests performed on a transformer
ASSESSMENT TASKS OR ACTIVITIES	
Theoretical assessment • Assess the students on the achievement of the learning outcomes listed Practical assessment • Students measure and compare primary and secondary voltage/ current of a transformer	

SUBJECT OUTCOME	
4.2 Explain three-phase transformers	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The basic principles of three-phase transformer construction are explained	• Explain the basic principles of three-phase transformer construction
• The four most common three-phase transformer connections are sketched and their respective uses and advantages and disadvantages are stated *Range: Delta-delta, delta-star, star-delta and star-star*	• Sketch the four most common three-phase transformer connections and state their respective uses and advantages and disadvantages
• Line / phase voltage and current are calculated	• Calculate line / phase voltage and current
• The operation and circuit connections of instrument transformers are explained *Range: Potential and current transformers*	• Explain the operation and circuit connections of instrument transformers
ASSESSMENT TASKS OR ACTIVITIES	
Theoretical assessment • Assess the achievement of the learning outcomes listed Practical assessment • Demonstrate the windings of a three-phase transformer • Students identify the different instrument transformers	

Topic 5: Electrical machines

SUBJECT OUTCOME	
5.1 Explain DC machines	
ASSESSMENT STANDARD	**LEARNING OUTCOME**
• The significance of back emf in a DC machine is explained	• Explain the significance of back emf in a DC machine
• The terminal voltage and generated emf of a generator is calculated *Range: Separately excited, self-excited (shunt and series), compound (long and short shunt) generators*	• Calculate terminal voltage and generated emf of a generator
• The characteristic curves (load characteristic) of DC generators in the range are drawn and explained	• Draw and explain the characteristic curves (load characteristic) of DC generators in the range
• The winding of compound generators is explained *Range: Differentially and cumulatively compound*	• Explain the winding of compound generators
• Level, over and under compounded generators are explained	• Explain level, over and under compounded generators
• The back emf and emf generated in a motor are calculated *Range: Series, shunt and compound (cumulative and differential) motors*	• Calculate the back emf and emf generated in a motor
• The characteristic curves (load characteristic) of DC motors in the range are drawn and explained	• Draw and explain the characteristic curves (load characteristic) of DC motors in the range
• The circuit diagram of the face-plate starter is drawn and its operating principle explained	• Draw a circuit diagram and explain the operating principle of the face-plate starter
• The two types of protective devices included in face-plate starters are listed and explained *Range: no-volt and overload protection*	• List and explain the two types of protective devices included in face-plate starters
• The different types of overload protective devices are explained *Range: Electromagnetic or dashpot type and thermal overload or bi-metal type*	• Explain the different types of overload protective devices
• The reversal of direction of rotation of DC motors is explained with the aid of sketches	• Explain with the aid of sketches how the direction of rotation of DC motors can be reversed

• Calculations are performed using the emf equation of a DC machine *Range: E = (2pøZN) ÷ (60 c) Volts*	• Use the emf equation of a DC machine to perform calculations
• The speed and torque of a DC motor are calculated *Range: N = (V) ÷ (kø) and T = (0,318I_aZpø) ÷ (c)*	• Calculate speed and torque of a DC motor

ASSESSMENT TASKS OR ACTIVITIES

Theoretical assessment

- Assess the achievement of the learning outcomes listed

Practical assessment

- Students identify the different types of motors
- Students identify the different types of overload protective devices

SUBJECT OUTCOME

5.2 Explain AC machines

Range: Three-phase and single-phase motors

ASSESSMENT STANDARD	LEARNING OUTCOME
• The operation of a three-phase induction motor is explained	• Explain the operation of a three-phase induction motor
• The operating characteristics of a three-phase squirrel-cage and wound-rotor motors are described and explained	• Describe and explain the operating characteristics of a three-phase squirrel-cage and wound-rotor motors
• The synchronous speed and slip of an induction motor are calculated	• Calculate the synchronous speed and slip of an induction motor
• Losses that occur in an induction motor are listed	• List losses that occur in an induction motor
• The no-load or open-circuit test and blocked rotor or short-circuit tests are described and reasons for conducting them given	• Describe the no-load or open-circuit test and blocked rotor or short-circuit tests and explain why they are conducted
• The factors affecting the performance of induction motors are listed	• List the factors affecting the performance of induction motors
• The operation of single-phase AC motors are explained with the aid of circuit diagrams *Range: Split-phase, capacitor-start capacitor-run, permanent capacitor, capacitor-start induction-run, resistance-start induction run, universal and shaded pole motors*	• Draw and explain with the aid of circuit diagrams the operation of single-phase AC motors

• Typical torque-speed characteristics of the AC motors in the range are sketched	• Sketch the typical torque-speed characteristics of the AC motors in the range
ASSESSMENT TASKS OR ACTIVITIES	
Theoretical assessment • Assess the achievement of the learning outcomes listed Practical assessment • Students identify the different AC machines and their respective connection diagrams.	

4 SPECIFICATIONS FOR EXTERNAL ASSESSMENT IN ELECTRICAL PRINCIPLES AND PRACTICE – LEVEL 4

4.1 Integrated summative assessment task (ISAT)

A compulsory component of the external summative assessment (ESASS) is the **integrated summative assessment task (ISAT)**. The ISAT draws on the students' 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 ISAT may be as follows:

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

OR

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

The ISAT 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 ISAT.

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 4	KNOWLEDGE AND COMPREHENSION	APPLICATION	ANALYSIS, SYNTHESIS AND EVALUATION
	50 - 60%	30 - 40%	0 - 20%