NATIONAL CERTIFICATES (VOCATIONAL

ASSESSMENT GUIDELINES

ELECTRICAL PRINCIPLES AND PRACTICE

NQF LEVEL 3

IMPLEMENTATION: JANUARY 2014
ELECTRICAL PRINCIPLES AND PRACTICE – 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 the subject Electrical Principles and Practice Level 3 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 the 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 3 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 qualifications 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 the 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 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 (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 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 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.

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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 (KSVAs) 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 (DHET) and Training 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 their 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;
- moderates 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 a competent assessor.
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 (KSVAs) 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 individual 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 include lecturer assessment, self-assessment, peer assessment and group assessment.

<table>
<thead>
<tr>
<th>LECTURER ASSESSMENT</th>
<th>The lecturer assesses students’ performance against given criteria in different contexts, such as individual work, group work, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELF-ASSESSMENT</td>
<td>Students assess their own performance against given criteria in different contexts, such as individual work, group work, etc.</td>
</tr>
<tr>
<td>PEER ASSESSMENT</td>
<td>Students assess another student’s or group of students’ performance against given criteria in different contexts, such as individual work, group work, etc.</td>
</tr>
<tr>
<td>GROUP ASSESSMENT</td>
<td>Students assess the individual performance of other students within a group or the overall performance of a group of students against given criteria.</td>
</tr>
</tbody>
</table>

9 INSTRUMENTS AND TOOLS FOR COLLECTING EVIDENCE

All evidence collected for assessment purposes is kept or recorded in the student’s Portfolio of Evidence.

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

<table>
<thead>
<tr>
<th>METHODS FOR COLLECTING EVIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Observation-based</strong></td>
</tr>
<tr>
<td>(Less structured)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Assessment instruments</strong></td>
</tr>
<tr>
<td>• Observation</td>
</tr>
<tr>
<td>• Class questions</td>
</tr>
<tr>
<td>• Lecturer, student, parent</td>
</tr>
<tr>
<td>discussions</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
**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, 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 as evaluation of specific tasks. However, marks should be awarded against rubrics and should not be simply 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.
SECTION C: ASSESSMENT IN ELECTRICAL PRINCIPLES AND PRACTICE LEVEL 3

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 examination mark for 50 percent of the final mark. A student needs a minimum final mark of 50 percent to enable 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 the 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 Level 3.

<table>
<thead>
<tr>
<th>TASKS</th>
<th>Time-frame</th>
<th>Type of assessment activity</th>
<th>Minimum time and proposed mark allocation (*can be increased but not reduced)</th>
<th>Scope of assessment</th>
<th>% contribution to the year mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Term 1</td>
<td>Test</td>
<td>1 hour (50 marks)</td>
<td>Topics completed in Term 1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Term 1</td>
<td>Practical Assessment/Assignment</td>
<td>Determined by the scope and nature of the task</td>
<td>One or more of the topics completed as an assignment</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Term 2</td>
<td>Practical Assessment/Assignment</td>
<td>Determined by the scope and nature of the task</td>
<td>One or more of the topics completed as an assignment</td>
<td>25</td>
</tr>
</tbody>
</table>

Do not confuse the weightings of topics in the Subject Guidelines with the % contribution to the year mark.
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 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, as is the case for all the other Vocational subjects, is assessed according to five levels of competence. The level descriptions are explained in the following table.

<table>
<thead>
<tr>
<th>Scale of Achievement for the Vocational component</th>
<th>RATING</th>
<th>MARKS %</th>
</tr>
</thead>
<tbody>
<tr>
<td>RATING CODE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Outstanding</td>
<td></td>
<td>80-100</td>
</tr>
<tr>
<td>4 Highly competent</td>
<td></td>
<td>70-79</td>
</tr>
<tr>
<td>3 Competent</td>
<td></td>
<td>50-69</td>
</tr>
<tr>
<td>2 Not yet competent</td>
<td></td>
<td>40-49</td>
</tr>
<tr>
<td>1 Not achieved</td>
<td></td>
<td>0-39</td>
</tr>
</tbody>
</table>

The planned/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 (memorandum, rubric, checklist) 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 students whose tasks have been moderated)

Where tasks cannot be contained as evidence in the Portfolio of Evidence, 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 3

Topic 1: Fundamentals of electricity

<table>
<thead>
<tr>
<th>SUBJECT OUTCOME</th>
<th>1.1 Explain fundamental concepts of electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSESSMENT STANDARD</strong></td>
<td><strong>LEARNING OUTCOME</strong></td>
</tr>
</tbody>
</table>
| • The fundamental concepts and terms used in electricity are distinguished. | • Distinguish the fundamental concepts and terms used in electricity
  Range: Structure of an atom, atomic number, atomic mass, electrons, free electrons, charge, electromotive force, current, potential difference and resistance. |
| • The effect of temperature on materials is explained. | • Explain the effect of temperature on materials
  Range: metals, carbon, insulator, alloys and semiconductor. |

**ASSESSMENT TASKS OR ACTIVITIES**

Assessment Tasks/Activities include but are not limited to:

- Written and verbal tests on the Learning Outcomes
- Students identify by means of graphs which materials are metals, carbon, insulator, alloys and semiconductor.

<table>
<thead>
<tr>
<th>SUBJECT OUTCOME</th>
<th>1.2 Calculate resistance of a material</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSESSMENT STANDARD</strong></td>
<td><strong>LEARNING OUTCOME</strong></td>
</tr>
<tr>
<td>• Resistivity is defined.</td>
<td>• Define resistivity.</td>
</tr>
</tbody>
</table>
| • The factors that influence the resistance of a material are stated and calculations are performed. | • State the factors that influence the resistance of a material and perform calculations.
  Range: Length, cross-sectional area, resistivity and temperature. |
| • The temperature coefficient of resistance is explained. | • Explain the temperature coefficient of resistance |
| • Distinctions are made between positive, negative and low temperature coefficient of resistance. | • Distinguish between positive, negative and low temperature coefficient of resistance. |
| • Calculations are performed to determine resistance of the material. | • Perform calculations to determine resistance using the formula
  Range: \( R_t = R_0 (1 + \alpha_0 t) \) and \( R_t = R_0 [1 + \alpha_0 (t - \theta)] \) |
### ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- Practical activities with different types of cables to demonstrate factors that influence the resistance of a material.
- Calculations do not include two different types of materials either in series or parallel.

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### Topic 2: Magnetism and electromagnetism

#### SUBJECT OUTCOME

2.1 Explain magnetic circuits

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The two fundamentals laws of magnetism are stated and explained.</td>
<td>• State and explain the two fundamentals laws of magnetism.</td>
</tr>
<tr>
<td>• The terms in the range are defined and the appropriate formulae are used to perform calculations. Range: magnetic flux, magnetic flux density, magnetomotive force (m.m.f), magnetic field strength.</td>
<td>• Define the following terms and use the appropriate formulae to perform calculations.</td>
</tr>
<tr>
<td>• Electrical and magnetic quantities are compared.</td>
<td>• Compare electrical and magnetic quantities.</td>
</tr>
</tbody>
</table>

#### ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- Demonstrations of the laws of magnetism with magnets
- The similarities and dissimilarities of electrical and magnetic quantities are listed in a table format

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#### SUBJECT OUTCOME

2.2 Explain electromagnetism

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The production of magnetic fields by electric currents is explained.</td>
<td>• Explain how magnetic fields are produced by electric currents.</td>
</tr>
<tr>
<td>• The right hand grip or screw rule is applied to determine the direction of magnetic field around a current carrying conductor and a solenoid.</td>
<td>• Apply the right hand grip or screw rule to determine the direction of magnetic field around a current carrying conductor and a solenoid.</td>
</tr>
<tr>
<td>• The applications of electromagnets are listed and explained.</td>
<td>• List and explain the applications of electromagnets. Range: bell, relay and lifting magnets.</td>
</tr>
</tbody>
</table>
- The factors affecting the force of a current-carrying conductor are listed.
- List the factors affecting the force of a current-carrying conductor.
- The magnitude of the force of a current-carrying conductor in a magnetic field is calculated.
- Calculate the magnitude of the force of a current-carrying conductor in a magnetic field.
- The force of attraction or repulsion between two-parallel current-carrying conductors is calculated.
- Calculate the force of attraction or repulsion between two-parallel current-carrying conductors.
- The Ampere is defined.
- Define Ampere.
- The operation of a simple DC motor is explained.
- Explain the operation of a simple DC motor.

ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- Students demonstrate the right hand grip or screw rule to determine the direction of magnetic field around a current carrying conductor and a solenoid.

SUBJECT OUTCOME

2.3 Explain electromagnetic induction

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>The principles of electromagnetic induction are explained.</td>
<td>Explain the principles of electromagnetic induction.</td>
</tr>
<tr>
<td>The laws of electromagnetic induction are stated</td>
<td>State the laws of electromagnetic induction.</td>
</tr>
<tr>
<td>The e.m.f. induced in a conductor is calculated.</td>
<td>Calculate the e.m.f. induced in a conductor.</td>
</tr>
<tr>
<td>The direction of the induced e.m.f. is determined by using Fleming's right hand rule and Lenz's law.</td>
<td>Determine the direction of the induced e.m.f. by using Fleming's right hand rule and Lenz's law.</td>
</tr>
</tbody>
</table>

ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes

Topic 3: Direct Current (DC) and Alternating Current (AC) circuits

SUBJECT OUTCOME

3.1 Explain and perform calculations using series-parallel network circuits

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>The total resistance, current and voltage drop for given circuits as stipulated in the range is calculated using different methods.</td>
<td>Calculate total resistance, current and voltage drop for given circuits using different methods. Range: series, parallel and series-parallel combination of resistors.</td>
</tr>
</tbody>
</table>
- Kirchhoff’s laws are applied in electric circuit calculations to verify answers.
- A practical circuit experiment is conducted to verify calculations within the range.

**ASSESSMENT TASKS OR ACTIVITIES**

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- Calculations are performed using different methods to verify answers, for example for series circuit the potential divider method is used and Kirchhoff’s laws
- Circuits are constructed on breadboards, the electrical quantities measured and compared with calculated values

### SUBJECT OUTCOME

3.2 Explain and perform calculations on the grouping of electrical cells

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Concepts such as e.m.f. of cells, internal resistance, terminal voltage and grouping of cells are explained.</td>
<td>• Explain concepts such as e.m.f. of cells, internal resistance, terminal voltage and grouping of cells. <strong>Range:</strong> series, parallel and series-parallel</td>
</tr>
<tr>
<td>• Calculations are performed for typical circuits involving the grouping of cells using practical examples.</td>
<td>• Perform calculations for typical circuits involving the grouping of cells using practical examples.</td>
</tr>
<tr>
<td>• The difference between primary and secondary cells is explained.</td>
<td>• Explain the difference between primary and secondary cells.</td>
</tr>
<tr>
<td>• Examples and applications of primary and secondary cells are listed.</td>
<td>• List examples and applications of primary and secondary cells.</td>
</tr>
</tbody>
</table>
| • Lead-acid batteries are sketched and explained, including:  
  - Names of the various parts  
  - The operating principles  
  - Function of the separators  
  - Maintenance and safety precautions to be taken  
  - Testing procedure  
  - Factors affecting battery capacity | • Sketch and explain lead-acid batteries |

**ASSESSMENT TASKS OR ACTIVITIES**

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- Students are given various cells and they must identify them.
- Students demonstrate the various parts of the lead-acid battery with correct naming and practical demonstration of how to maintain and test batteries by adhering to all safety precautions.
### SUBJECT OUTCOME

3.3 Perform calculations for capacitors in series-parallel

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>The explanation of how a capacitor can store charge is given.</td>
<td>Explain how a capacitor can store charge.</td>
</tr>
<tr>
<td>Common types of capacitors are listed.</td>
<td>List common types of capacitors.</td>
</tr>
<tr>
<td>Capacitance, charge, electric field strength and energy stored in a capacitor are explained and calculated.</td>
<td>Explain and calculate capacitance, charge, electric field strength and energy stored in a capacitor.</td>
</tr>
<tr>
<td>The total capacitance, charge on each capacitor and potential difference across each capacitor are calculated when capacitors are connected in series, parallel and series-parallel.</td>
<td>Calculate total capacitance, charge on each capacitor and potential difference across each capacitor when capacitors are connected in series, parallel and series-parallel.</td>
</tr>
</tbody>
</table>

### ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- Students identify various capacitors such as variable air, mica, paper, ceramic and electrolytic capacitors.

---

### SUBJECT OUTCOME

3.4 Perform calculations for inductors in series-parallel

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductance, self inductance and mutual inductance are explained.</td>
<td>Explain inductance, self inductance and mutual inductance.</td>
</tr>
<tr>
<td>The energy stored in a magnetic circuit is calculated.</td>
<td>Calculate energy stored in a magnetic circuit.</td>
</tr>
<tr>
<td>The value of e.m.f. induced in a coil is calculated.</td>
<td>Calculate the value of e.m.f. induced in a coil.</td>
</tr>
<tr>
<td>The factors that affect the inductance in an inductor are listed.</td>
<td>List the factors that affect the inductance in an inductor.</td>
</tr>
<tr>
<td>The total inductance in series, parallel and series-parallel circuits is calculated.</td>
<td>Calculate total inductance in series, parallel and series-parallel circuits.</td>
</tr>
</tbody>
</table>

### ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
### SUBJECT OUTCOME

#### 3.5 Explain single and three-phase systems

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>The single and three-phase supply systems are described.</td>
<td>Describe single and three-phase supply systems.</td>
</tr>
<tr>
<td>The concept of phase angle between waveforms is understood.</td>
<td>Understand the concept of phase angle between waveforms.</td>
</tr>
<tr>
<td>The terms for a sine wave are explained. <em>Range: Cycle, period, frequency, instantaneous value, peak value and peak to peak value.</em></td>
<td>Explain the following terms for a sine wave.</td>
</tr>
<tr>
<td>Star and delta connections are explained and compared.</td>
<td>Explain and compare star and delta connections.</td>
</tr>
<tr>
<td>Line voltage, line current, phase voltage and phase current in a typical scenario are calculated.</td>
<td>Explain and calculate line voltage, line current, phase voltage and phase current in a typical scenario.</td>
</tr>
<tr>
<td>Power is calculated in single and three-phase systems.</td>
<td>Calculate power in single and three-phase systems.</td>
</tr>
</tbody>
</table>

#### ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- By means of sketches students identify single and three-phase systems and determine phase angle
- Students calculate values related to a sine wave
- Students explain and compare star and delta connections from sketches and calculate line voltage, line current, phase voltage and phase current and power in a typical scenario.

### SUBJECT OUTCOME

#### 3.6 Explain and perform calculations with transformers

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
</table>
| The principle of operation and the rating of a transformer are explained. | Explain the principle of operation of a transformer.  
| Explain the rating of a transformer. |
| The advantages, disadvantages and applications of auto-transformers are listed. | List the advantages, disadvantages and applications of auto-transformers. |
| Distinctions are made between different types of transformers and related terminology is explained. | Distinguish between different types of transformers and explain related terminology. *Range: turns ratio, step-up and step up transformers.* |
| The ideal transformers equation is used to perform calculations (single-phase). | Use ideal transformers equation to perform calculations (single-phase). |
| The losses in a transformer are listed and efficiency is calculated. | List losses in a transformer and calculate efficiency. |
- Construction of three-phase transformers is explained.
- The different possible transformer connections are sketched and their uses are given. 
  *Range: Delta-delta, delta-star, star-delta and star-star.*
- Transformer equations are used to perform calculations (three-phase).
- The methods of cooling of dry type and oil immersed type transformers are listed and explained. 
  *Range: Dry type – Natural air and forced air. Oil immersed type - self, forced air and forced oil cooled transformer.*
- The function of the conservator, breather and Buchholz relay of a transformer is explained.

### ASSESSMENT TASKS OR ACTIVITIES
Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- Students must be able to identify different types of transformers and cooling methods from sketches and pictures.
- Students measure input and output voltages to determine if transformers are step-up or step-down.

---

**Topic 4: Measuring instruments**

<table>
<thead>
<tr>
<th>SUBJECT OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.1 Sketch and explain the fundamentals of measuring instruments</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
</table>
| - The devices that an analogue instrument consists of are listed and explained. 
  *Range: Deflecting, controlling and damping devices.* | - List and explain the devices that an analogue instrument consists of. |
| - The operation of moving-iron instruments is described. 
  *Range: Attraction and repulsion type.* | - Describe the operation of moving-iron instruments. |
| - The operation of moving-coil instruments is described. 
  *Range: Permanent-magnet and dynamometer type.* | - Describe the operation of moving-coil instruments. |
| - The advantages and disadvantages of moving-iron and moving-coil instruments are listed | - List the advantages and disadvantages of moving-iron and moving-coil instruments. |
| - The measurement of power in single and three-systems is explained. | - Explain how power in single and three-systems is measured. |
The value of the series resistor is calculated to extend the range of a voltmeter.

Calculate the value of the series resistor to extend the range of a voltmeter.

The value of the shunt resistor is calculated to extend the range of an ammeter.

Calculate the value of the shunt resistor to extend the range of an ammeter.

ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:

- Written and verbal tests on the Learning Outcomes
- Students must be able to identify different moving-iron and moving-coil instruments
- Measurement of power for three-phase systems includes the following: One wattmeter method for a balanced load, two wattmeter method for balanced or unbalanced loads and three wattmeter method for a three-phase four-wire system for balanced and unbalanced loads.
- Students perform practical exercises with various measuring instruments to measure electrical quantities.

SUBJECT OUTCOME

4.2 Explain how to use and care for hand-held measuring instruments

Range: Ammeter, Voltmeter, multimeter, voltage testers, clamp-meter and insulation resistance meter.

ASSESSMENT STANDARD

- Distinctions are made between analogue and digital meters.
- The advantages of using digital meters are stated.
- The concept of parallax error is explained.
- The instruments in the range are set up for use and demonstrated in a practical situation.
- The correct care and storage of the instruments in the range is explained.

LEARNING OUTCOME

- Distinguish between analogue and digital meters.
- State the advantages of using digital meters.
- Explain the concept of parallax error.
- Set up and demonstrate the measuring instruments in the range for use in a practical situation.
- Explain the correct care and storage of the instruments in the range.

ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:

- Written and verbal tests on the Learning Outcomes
- Students must be able to demonstrate the concept of parallax error when using analogue instruments
- Students use Ammeters, Voltmeters, multimeters, voltage testers, clamp-meters and insulation resistance meters in circuits to take measurements
- Students demonstrate how to care for and store instruments.
### Topic 5: Electric machines

#### SUBJECT OUTCOME

<table>
<thead>
<tr>
<th>ASSESSMENT TASKS OR ACTIVITIES</th>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.1 Sketch and explain DC machines</strong></td>
<td>The functions of a motor and a generator are explained.</td>
<td>Explain the functions of a motor and a generator.</td>
</tr>
<tr>
<td></td>
<td>The construction of a DC machine is explained.</td>
<td>Explain the construction of a DC machine.</td>
</tr>
<tr>
<td></td>
<td>The difference between lap and wave windings is distinguished.</td>
<td>Distinguish between lap and wave windings.</td>
</tr>
<tr>
<td></td>
<td>The concept of armature reaction is explained.</td>
<td>Explain armature reaction.</td>
</tr>
<tr>
<td></td>
<td>The types of DC generators are listed and explained</td>
<td>List and explain types of DC generators</td>
</tr>
<tr>
<td></td>
<td><em>Range: separately excited, self excited, shunt, series, compound generator</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Terminal voltage and generated e.m.f. of a generator are calculated using the formula $V = E - I_aR_a$</td>
<td>Calculate terminal voltage and generated e.m.f. of a generator using the formula $V = E - I_aR_a$</td>
</tr>
<tr>
<td></td>
<td>The types of DC motors are listed and explained.</td>
<td>List and explain types of DC motors.</td>
</tr>
<tr>
<td></td>
<td><em>Range: Series, shunt and compound motors</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The back e.m.f. of a motor is calculated using the formula $E = V - I_aR_a$.</td>
<td>Calculate back e.m.f. of a motor using the formula $E = V - I_aR_a$.</td>
</tr>
<tr>
<td></td>
<td>Losses in a DC machines are listed.</td>
<td>List losses in DC machines</td>
</tr>
<tr>
<td></td>
<td><em>Range: Copper loss, iron (or core) loss, friction and windage losses and brush contact loss</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The characteristics and applications of DC motors are listed.</td>
<td>List the characteristics and applications of DC motors.</td>
</tr>
<tr>
<td></td>
<td>The purpose of a DC motor starter is explained.</td>
<td>Explain the purpose of a DC motor starter.</td>
</tr>
<tr>
<td></td>
<td>Speed control of DC motors is explained.</td>
<td>Explain how speed of DC motors can be controlled.</td>
</tr>
</tbody>
</table>

#### ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:
- Written and verbal tests on the Learning Outcomes
- Students dismantle a DC machine to identify the parts
- Students identify the different types of generators and motors
- Students demonstrate different methods of controlling speed of DC motors
### SUBJECT OUTCOME

#### 5.2 Sketch and explain AC Machines

<table>
<thead>
<tr>
<th>ASSESSMENT STANDARD</th>
<th>LEARNING OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The types of single-phase AC motors are listed and explained. <em>Range: Split-phase, capacitor-start capacitor-run, permanent capacitor, capacitor-start induction-run, resistance-start induction-run, universal and shaded pole motors</em></td>
<td>• List and explain types of single-phase AC motors</td>
</tr>
<tr>
<td>• The applications, advantages and disadvantages of the motors in the range are listed.</td>
<td>• List the applications, advantages and disadvantages of the motors in the range.</td>
</tr>
<tr>
<td>• The operation of a three-phase induction motor is explained</td>
<td>• Explain how a three-phase induction motor operates.</td>
</tr>
<tr>
<td>• The advantages and applications of three-phase inductions motors are listed.</td>
<td>• List the advantages and applications of three-phase induction motors.</td>
</tr>
<tr>
<td>• The applications, advantages and disadvantages of squirrel cage rotors and wound rotor motors are listed.</td>
<td>• List the applications, advantages and disadvantages of squirrel cage rotors and wound rotor motors.</td>
</tr>
<tr>
<td>• The types of motor starters are listed and explained. <em>Range: Direct on-line, star-delta and auto-transformers.</em></td>
<td>• List and explain types of motor starters.</td>
</tr>
<tr>
<td>• The means of protection of motors in a circuit is stated and explained.</td>
<td>• State and explain how motors are protected in a circuit.</td>
</tr>
</tbody>
</table>

### ASSESSMENT TASKS OR ACTIVITIES

Assessment Tasks/Activities include but are not limited to:

- Written and verbal tests on the Learning Outcomes
- Students dismantle AC motors to identify the parts
4 SPECIFICATION FOR EXTERNAL ASSESSMENT IN ELECTRICAL PRINCIPLES AND PRACTICE – LEVEL 3

4.1 Integrated summative assessment task (ISAT)

A compulsory component of the external assessment (EASASS) 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 will have to 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 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 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 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:

<table>
<thead>
<tr>
<th>LEVEL 3</th>
<th>KNOWLEDGE AND COMPREHENSION</th>
<th>APPLICATION</th>
<th>ANALYSIS, SYNTHESIS AND EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 - 60%</td>
<td>30 -40%</td>
<td>0 - 10%</td>
</tr>
</tbody>
</table>