education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

ELECTRICAL SYSTEMS AND CONSTRUCTION

NQF Level 4

September 2007

ELECTRICAL SYSTEMS AND CONSTRUCTION – LEVEL 4

CONTENTS

INTRODUCTION

A. What is Electrical Systems and Construction?

In Level 2, Electrical Systems and Construction covers the basics of electrical systems and introduces this particular field of learning. It teaches students basic construction skills that are commonly found in the electrical field of practice. Students come into contact with standard Electrical Systems and Construction procedures.

In Level 3, the subject covers the basics of electrical systems and construction procedures. In Level 4, it covers some of the daily tasks of an electrical tradesperson and introduces the practical side of this field of learning. In Levels 3 and 4, students continue with the theoretical and practical implementation of the learning material. Some of the Level 2 theoretical knowledge is repeated in greater detail to further embed students' knowledge.

B. Why is Electrical Systems and Construction important in the Electrical Infrastructure Construction programme?

Electrical Systems and Construction addresses the necessary trade-specific skills, knowledge, values and attitudes so that students can understand the construction and application of electrical systems in practice.

C. The link between the Learning Outcomes for Electrical Systems and Construction and the Critical and Developmental Outcomes

This subject covers a substantial portion of the practical knowledge component of electrical systems found in practice. With particular reference to Electrical Systems and Construction procedures, students should be able to:

- Identify and solve problems:
  - Recognise situations that require action and react appropriately.
- Work effectively with others:
  - Construct and test projects in groups or teams.
- Organise and manage themselves and their activities:
  - Apply the correct procedures for using, storing and looking after equipment, tools, test equipment, drawings and parts.
- Collect, organise and evaluate information and take appropriate action:
  - Use media centres to collect information.
- Communicate effectively:
  - Use common names for equipment, tools, test equipment, drawings and parts.
- Use science and technology:
  - Use and apply science and technology principles in both theory and practice.
- Demonstrate understanding of subject content through the application of acquired knowledge:
  - Solve problems by using subject content.

D. Factors that contribute to achieving the Electrical Systems and Construction Learning Outcomes

- An understanding of technical (electro-mechanical) principles
- Analytical ability
- An ability to do mathematical calculations and manipulations
- Practical skills
- Skill to interpret technical information

1 DURATION AND TUITION TIME

This is a one year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided all of the assessment requirements set out hereunder are adhered to.

2 SUBJECT LEVEL FOCUS

- Understand electrical infrastructure
- Maintain three-phase installations
- Apply worksite practices and procedures
- Conform to statutory requirements
- Gain practical experience

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (50 percent)

3.1.1 Theoretical Component

The theoretical component will form 40 percent of the internal assessment.

3.1.2 Practical Component

The practical component will form 60 percent of the internal assessment.

All practical components must be indicated in a Portfolio of Evidence (PoE).

Please note that a mathematical calculation that makes use of the theoretical background of the student can be considered to be the practical component.

3.1.3 Processing of internal assessment mark for the year

A year mark out of 100 is calculated by adding the marks of the theoretical component and the practical component of the internal continuous assessment.

3.1.4 Moderation of internal assessment mark

Internal assessment is subject to internal and external moderation procedures as set out in the *National Examinations Policy forFurther Education and Training College Programmes*.

3.2 External assessment (50 percent)

A national examination is conducted annually in October or November by means of a paper/s set externally and marked and moderated internally.

External assessment details are set out in the *Assessment Guideleins: Electrical Systems and Construction* (Level 4).

4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Electrical Infrastructure	20
2. Design and construct a three phase circuit	20
3. Construct a Three Phase Medium Voltage Overhead Supply to domestic houses	20
4. Test and inspect a three phase industrial/commercial installation	20
5. Fault-find, repair and maintain three phase voltage electric circuits	20
TOTAL	**100**

5 CALCULATION OF FINAL MARK

Continuous assessment:	Student's mark/100 x 50/1 = a mark out of 50	(a)
Examination mark:	Student's mark/100 x 50/1= a mark out of 50	(b)
Final mark:	**(a) + (b) = a mark out of 100**	

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, purposes of moderation and verification.

6 PASS REQUIREMENTS

The student must obtain at least fifty (50) percent in ICASS and fifty percent (50) in the examination.

7 SUBJECT OUTCOMES AND LEARNING OUTCOMES

On completion of Electrical Systems and Construction Level 4 the student should have covered the following topics:

Topic 1: Electrical infrastructure
Topic 2: Design and construct a three phase circuit
Topic 3: Construct a three phase medium voltage overhead supply to domestic houses
Topic 4: Test and inspect a three phase industrial/commercial installation
Topic 5: Fault-find, repair and maintain three phase voltage electric circuits

7.1 Topic 1: Electrical infrastructure

7.1.1 Subject Outcome 1: Know about electrical infrastructure and construction.

Range: Includes but is not limited to knowledge of the layout of the South Africa power grid, operating principles of coal fired power stations, layout of a typical small town power grid and how to install and terminate medium voltage overhead networks.

Learning Outcomes:

- Understand the concepts high voltage networks, medium voltage networks and low voltage networks.
- Understand the ratings on switchgear, transformers, control gear and Instruments.
- Understand how alternators can be switched into or out of the grid.
- Explain with the aid of diagrams, the main components of a coal fired power station.
- Explain with the aid of diagrams, the main components of a typical small town power grid.
- Explain radial and ring feeds and the effects of faulty transmission lines (short circuit and open circuit).
- List and explain component parts and equipment required to install medium voltage overhead networks.

7.2 Topic 2: Design and construct a three phase circuit.

7.2.1 Subject Outcome 1: Design and construct a three phase circuit.

Range: includes but is not limited to; identifying electrical symbols (ISO and IEC standard) and components, gathering relevant components and describing the functioning of circuits and components (includes the following components; contactors, protection (fuses, circuit breakers, earth leakage and over load relays), controls (temperature, limits, pressure, level, proximity and time switches), loads (resistive and inductive) and power supplies (Maximum 550 volt). Circuits to be constructed in a simulated environment and tested under supervision.

Learning Outcomes:

- Identify symbols (ISO and IEC standard) and components.
- Interpret the task and format a logical plan of action.
- Design a three phase circuit diagram that will satisfy the requirements.
- Compose a list of components, tools and equipment needed for the construction of the circuit.
- Construct the three phase circuit using acceptable working procedures and construction methods.
- Evaluate the operational function of the constructed circuit and address any shortcomings.
- Rigorously test the design by applying load tests (if applicable).
- Complete the task by compiling drawings, operating procedures and specifications of the design.

7.3 Topic 3: Construct a three phase medium voltage overhead supply to domestic houses.

7.3.1 Subject Outcome 1: Construct a three phase medium voltage overhead supply to domestic houses.

Range: Includes but is not limited to; 11kV/380V three phase 4-wire network, materials such as cables, conductors, aerial bundle conductors, poles, isolators and fuses, and pin and strain type insulators, a 220V single phase supply cable to a domestic house, connection to the consumer's meter box. Excludes; mounting of 11kV/380V transformer on structure (assumed to be in place), plans (will be provided) and connection to the 11kV supply.

Learning Outcomes:

- State all statutory requirements as prescribed by the OHS Act, SABS 1418, Local Authority requirements and ESKOM reticulation specifications.
- State worksite procedures.
- Draw up a list of parts and equipment needed by studying the plans and diagrams.
- Assess the terrain and decide on work to be done.
- Mark out the route according to diagrams and servitude specifications.
- Prepare holes or foundations, erect structures or poles, connect the stays, string the conductive elements and tension the lines.
- Connect the 220V cable to the overhead supply; connect the transformer, isolator, fuses and other parts as per statutory requirements.
- Remove and dispose of surplus material and restore the terrain according to environmental standards and land owner's requirements.
- Conclude the task by completing the inspection sheets and pre-commissioning reports.

7.4 Topic 4: Test and inspect a three phase industrial/commercial installation

7.4.1 Subject Outcome 1: Test and inspect a three phase industrial/commercial installation.

Range: Includes schools, office buildings, factories, shops and townhouse complexes, conducting an electrical test and inspection of a three phase industrial/commercial installation to ensure compliance with all statuary requirements and that they have been applied to the installation, using appropriate test instruments and understanding the indicated results, using appropriate inspection documents, completing the appropriate inspection documents with correct and relevant information. Test equipment may include but are not limited to multimeters, insulation tester, clip on ammeter, impedance testing equipment, earth leakage testing devices, earth electrode resistance testing equipment, continuity testers, phase rotation meters and any others appropriate to three phase industrial/commercial installations. All work must be conducted under supervision.

Learning Outomes:

- Understand the building plans and electric schematic and wiring diagrams.
- The correct documentation necessary to complete the task is obtained as per management requirements.
- Identify the switch-yards, cabling, wire-ways, distribution boards and points of delivery and correlate this with the building plans and electric schematic and wiring diagrams.
- Identify the circuit protection devices and correlate this with the electric schematic and wiring diagrams
- Identify the various sub-circuits within the buildings and correlate this with the electric schematic and wiring diagrams.
- Plan the tasks required for inspecting and testing the installation.
- Appropriate tools, equipment and instruments are identified and selected to meet the requirements of the task according to statutory and environmental requirements.
- The safety rules and regulations regarding the task are understood according to statutory requirements and safe work procedures.
- Environmental hazards and safety risks are identified according to environmental standards and safety risk analyses.
- The installation is inspected for compliance according to statutory and environmental requirements.
- Installation is tested according to the statutory requirements from the wiring code.
- The measurements obtained from the test is understood and demonstrated in context with the wiring code specifications.
- The premises is left the way it was found and documents required for the test and inspection are completed and handed to the supervisor.

7.5 Topic 5: Fault-find, repair and maintain three phase voltage electric circuits

7.5.1 Subject Outcome 1: Fault-find three phase voltage electric circuits.

Range: Includes but is not limited to; 380V three phase, equipment such as transformers, motors and control gear, domestic appliances, cables, lighting, switch gear and metering. Safety policies must be adhered to. Fault finding must be done under supervision. Faults are simulated in a simulated environment.

Learning Outcomes:

- Explain the principles and procedures to be applied during fault finding on three phase AC systems.
- Plan and prepare for fault finding on three phase AC systems.
- Find faults on faulty three phase AC systems.
- Complete fault finding on three phase AC systems.

7.5.2 Subject Outcome 2: Repair three phase voltage electric circuits.

Range: Includes but is not limited to; 380V three phase, equipment such as transformers, motors and control gear, domestic appliances, cables, lighting, switch gear and metering. Safety policies must be adhered to. Repair procedures must be done in accordance with accepted practises. Faults are simulated in a simulated environment.

Learning Outcomes:

- Explain the principles and procedures to be for repairing three phase AC systems.
- Plan and prepare for for repairing three phase AC systems.
- Repair faulty three phase AC systems.
- Test and commission the repaired three phase AC system.

7.5.3 Subject Outcome 3: Maintain three phase voltage electric circuits.

Range: Includes but is not limited to; 380V three phase, equipment such as transformers, motors and control gear, domestic appliances, cables, lighting, switch gear and metering. Safety policies must be adhered to. Maintenance procedures must be done under supervision. Faults are simulated in a simulated environment.

Learning Outcomes:

- Explain the principles and procedures to be applied during maintenance on three phase AC systems.
- Plan and prepare for maintenance on three phase AC systems.
- Maintain three phase AC systems.
- Record data and schedule next maintenance on the three phase AC system.

8 RESOURCE NEEDS FOR THE TEACHING OF ELECTRICAL SYSTEMS AND CONSTRUCTION - LEVEL 4

8.1 Physical resources

Well equipped classrooms and workshops are essential for this practical orientated subject. If possible, using the facilities of employers in the electrical field, for training, is preferred.

8.2 Human resources

Registered post level 1 or higher educators at FET institutions.

8.3 Financial resources

The institution should make provision for

- consumables during practicals,
- maintenance of physical recourses and
- purchasing of new equipment. `