education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATES (VOCATIONAL)

SUBJECT GUIDELINES

ELECTRONIC CONTROL AND DIGITAL ELECTRONICS

NQF LEVEL 2

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INTRODUCTION

A. What is Electronic Control and Digital Electronics?

Electronic Control and Digital Electronics Level 2 covers the basics of electronics and is designed to introduce the field of learning. As this subject becomes more and more embedded in electrical systems, students need to know what Electronic Control and Digital Electronics modules receive as inputs, do with the input to produce an output and what the output looks like and how it affects the operation of the electrical system. It is assumed that students will have no previous electronic background.

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 with greater detail to further embed students' knowledge.

B. Why is Electronic Control and Digital Electronics important in the Electrical Infrastructure Construction programme?

Electronic Control and Digital Electronics transfers the necessary trade-specific skills, knowledge, values and attitudes for students to understand, maintain, repair and construct basic electronic systems in practice.

C. The link between the Electronic Control and Digital Electronics Learning Outcomes and the Critical and Developmental Outcomes

This subject covers a small portion of the basic theoretical and practical knowledge component of Electronic Control and Digital Electronics. The inclusion of this subject is not to produce students who are electronic or digital experts but to familiarise the student with basic circuitry to understand electrical systems better. This subject is outcomes-based orientated and relates to the Critical and Developmental Outcomes. With particular reference to Electronic Control and Digital Electronics 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 Electronic Control and Digital Electronics Learning Outcomes

- An understanding of technical (electro-mechanical) principles
- Analytical ability
- An ability to do mathematical calculations and manipulations
- Hand skills (practical skills)
- Practical improvisation abilities

ELECTRONIC CONTROL AND DIGITAL ELECTRONICS – LEVEL 2

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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 the student meets all the assessment requirements.

Students with special education needs (LSEN) must be catered for in a way that eliminates barriers to learning.

2 SUBJECT LEVEL FOCUS

The student should be able to:

- Use basic electronic test equipment and tools.
- Identify, rate and explain the functioning of basic electronic components.
- Draw simple electronic circuits using generally accepted circuit symbols.
- Explain digital electronic principles.
- Identify and explain the function of basic computer components.
- Understand how controllers sense and react to physical conditions.

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (50 percent)

All internal assessments must be finalised by an assessor with at least a certificate of competence.

3.1.1 Theoretical component

The theoretical component forms 60 percent of the internal assessment mark.

3.1.2 Practical component

The practical component forms 40 percent of the internal assessment mark.

Practical components include applications and exercises. All practical components must be indicated in a Portfolio of Evidence (PoE).

Note: Mathematical calculations that use students' theoretical background can be considered as part of 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 (60 percent) and the practical component (40 percent) of the internal continuous assessment (ICASS).

3.1.4 Moderation of internal assessment mark

Internal assessment is subjected to internal and external moderation procedures as set out in the *National Examinations Policy for FET 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 and moderated externally. A practical component will also be assessed.

External assessment details and procedures are set out in the *Assessment Guidelines: Electronic Control and Digital Electronics* (Level 2).

4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Components and Circuit Drawings	45
2. Binary Theory and Basic Computer Components	45
3. Transducers Used In Process Control	10
TOTAL	**100**

5 CALCULATION OF FINAL MARK

Internal assessment mark: Student's mark/100 x 50 = a mark out of 50 (a)

Examination mark: Student's mark/100 x 50 = 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, reporting, moderation and verification purposes.

6 PASS REQUIREMENTS

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

7 SUBJECT AND LEARNING OUTCOMES

On the completion of Electronic Control and Digital Electronics Level 2, the student should have covered the following topics:

Topic 1: Components and Circuit Drawings
Topic 2: Binary Theory and Basic Computer Components
Topic 3: Transducers Used In Process Control

7.1 Topic 1: Components and Circuit Drawings

Subject Outcome 1: Use basic electronic tools and measuring equipment.

Learning Outcomes:

The student should be able to:
- Understand the layout of a breadboard by using an ohmmeter or continuity tester.
- Demonstrate the use of a voltmeter.

Subject Outcome 2: Identify and rate basic electronic components.

Range: Resistors and potentiometers, capacitors (polarised and non-polarised), inductors, relays, transformers, diodes (rectifier, high speed, zener light emitting), bi-junction transistors and integrated circuits (regulators, analogue op-amps and digital gates)

Learning Outcomes:

The student should be able to:
- Recognise and name the components in the range.
- Indicate the rating of the components in the range by means of the physical markings on them.

Subject Outcome 3: Read and draw symbols of electronic components, elementary circuit drawings and elementary sketches.

Range: Resistors and potentiometers, capacitors (polarised and non-polarised), inductors, relays, transformers, diodes (rectifier, high speed, zener light emitting), bi-junction transistors and integrated circuits (regulators, analogue op-amps and digital gates)

Learning Outcomes:

The student should be able to:
- Recognise the symbols of the components in the range.
- Sketch the symbols of the components in the range.
- Understand elementary circuit drawings and elementary sketches. Sketch elementary circuit drawings and elementary sketches.

Subject Outcome 4: Explain the functioning of electronic components.

Range: Resistors and potentiometers, capacitors (polarised and non-polarised), inductors, relays, transformers, diodes (rectifier, high speed, zener light emitting), bi-junction transistors and integrated circuits (regulators, analogue op-amps and digital gates)

Learning Outcomes:

The student should be able to:

- Classify the components in the range according to their functions.
- Describe the basic functions and operation of the components in the range.
- Demonstrate the ability to test resistors, capacitors and inductors with the appropriate test equipment.
- Demonstrate the ability to test diodes and bi-junction transistors with a diode tester or an ohmmeter (digital or analogue).
- Demonstrate how to look up semi-conductor components in a technical manual.
- Build working circuits using digital gates to construct truth tables from empirical evidence.

  Range: Not (inverter), and, nand, or, nor, xor and xnor

Subject Outcome 5: Construct basic series and parallel circuits on breadboards.

Range: Resistors, capacitors and inductors

Learning Outcomes:

The student should be able to:

- Demonstrate the ability to build series and parallel circuits on breadboards.
- Calculate the outcomes of the built circuits and verify the outcomes using the appropriate meters.
- Demonstrate the ability to mount, wire and connect components.

7.2 Topic 2: Binary Theory and Basic Computer Components

Subject Outcome 1: Explain digital electronic principles.

Learning Outcomes:

The student should be able to:

- Demonstrate an ability to convert between the binary and decimal systems and vice versa by means of calculations.
- Demonstrate an ability to count in the binary system.
- Define and explain the binary system in terms of voltage levels.
- Differentiate between odd and even parity and explain how they are generated.
- Build working circuits using flip-flops to construct their truth tables from empirical evidence.

  Range: D-type and JK-type and RS and T-type flip-flops simulated by using JK flip-flops
- Construct simple binary up/down counters (asynchronous and synchronous) using D-type and JK-type flip-flops from a circuit diagram.
- Explain how encoding and decoding takes place by building each circuit type using gates.

  Size: 4 bits
- Explain the purpose of shift registers.

Subject Outcome 2: Explain the functions of the basic components that make up a personal computer.

Learning Outcomes:

The student should be able to:

- Distinguish between hardware, software and firmware.
- Recognise and name the components in a personal computer.

  Range: Power supply and connections, motherboard and connections, CPU, RAM, ROM, secondary memories (hard disk, CD, DVD and flash memory), peripherals (monitor, keyboard, mouse, printer, fax, scanner) and ports (PS/2, VGA, RT-45, USB)
- Describe the functions of the components in a personal computer.

  Range: Power supply and connections, motherboard and connections, CPU, RAM, ROM, secondary memories (hard disk, CD, DVD and flash memory), peripherals (monitor, keyboard, mouse, printer/fax/scanner) and ports (PS/2, VGA, RT-45, USB)
- Distinguish between volatile and non-volatile memories.
- Explain how the binary levels are stored in the peripheral memory devices.

  Range: Hard disk, CD, DVD and flash memory

7.3 Topic 3: Transducers Used In Process Control

Subject Outcome 1: Explain how controllers sense and react to physical conditions.

Range: Level, pressure, temperature and light

Learning Outcomes:

The student should be able to:

- Distinguish between analogue signals and digital signals.
- Explain how and why analogue signals are converted to digital signals and vice versa.
- Recognise and name simple non-electrical examples of instruments that measure the physical conditions in the range.
- Identify the limitations of using the instruments named as sensors for an electric controller.
- Recognise and name examples of transducers that sense the physical conditions in the range.
- Classify the transducers named according to their functions.
- Describe the function of the transducers named.
- Describe the construction and basic operation of the transducers named.