education

Department:
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REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SUBJECT GUIDELINES

ELECTRONIC CONTROL AND DIGITAL ELECTRONICS

NQF Level 3

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ELECTRONIC CONTROL AND DIGITAL ELECTRONICS – LEVEL 3

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INTRODUCTION

A. What is Electronic Control and Digital Electronics?

Electronic Control and Digital Electronics Level 2 and 3 cover the basics of electronics and are 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. In level 3 the student will begin to see the connections between electronic system components and the function of the module. During level 4 the students will be able to integrate modules to form a system that is operational.

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

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

- Demonstrate the practical usage of measuring instruments
- Identify, rate and explain the functioning of electronic components
- Construct rectifier, amplifier and tuned RLC circuits and explain their operation
- Demonstrate an ability to work within the binary system
- Demonstrate an ability to assemble and boot a computer and to troubleshoot hardware faults
- Explain how controllers sense and react to physical conditions
- Demonstrate a basic knowledge of PLC's

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (constitutes 50 percent of the final mark)

An assessor with at least a certificate of competence must finalize all internal assessments.

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% 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 for Further Education and Training College Programme.*

3.2 External assessment (constitutes 50 percent of the final mark)

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

External assessment details are set out in the *Assessment Guidelines: Electronic Control and Digital Electronics* (Level 3).

4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1.1 Use of measuring instruments (section 1)	10%
1.2 Components and rectifier, amplifier and tuned RLC circuits (section 1)	30%
2.1 Binary Arithmetic (section 2)	20%
2.2 Assembling a computer and hardware faults (section 2)	10%
3. More transducers and an introduction to ladder logic as used in PLCs (section 3)	30%
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 students must obtain at least fifty (50) percent in ICASS and fifty (50) percent in the examination.

7 SUBJECT AND LEARNING OUTCOMES

On completion of Electronic Control and Digital Electronics Level 3 the student should have covered the following topics:

Topic 1: Measuring instruments, electronic components and building circuits
Topic 2: Binary arithmetic and assembly of a computer
Topic 3: Introduction to ladder logic as used in PLCs

7.1 Topic1: Measuring instruments, electronic components and building circuits

7.1.1 Subject Outcome 1: Demonstrate the practical use of measuring instruments.

Range: Digital multimeter with and without auto-ranging, oscilloscope.

Learning Outcome:

- Demonstrate how to take care of the measuring instruments in the range.
- Demonstrate how to use the measuring instruments in the range.

7.1.2 Subject Outcome 2: Identify and rate electronic components.

Range: Diodes (varactor and tunnel), field-effect transistors (JFET and MOSFET), silicon controlled rectifiers, diacs and triacs.

Learning Outcome

- Recognise the electronic symbols of the components in the range.
- Sketch the electronic symbols of the components in the range.
- Demonstrate how to look up the ratings of the components in the range using a technical manual.
- Describe the basic function, construction and operation of the components in the range.

7.1.3 Subject Outcome 3: Construct basic electronic circuits.

Range: Includes components such as resistors, capacitors, inductors, diodes, transistors and analogue op-amps. Mounting can be done on bread board.

Learning Outcome

- Describe the uses, application and functioning of RLC circuits with particular reference to resonance.
- Describe the uses, application and functioning of rectifier circuits.
- Explain the difference between and applications of positive and negative feedback.
- Describe the uses, application and functioning of single stage amplifier circuits using transistors.
- Describe the uses, application and functioning of amplifier circuits using op-amps.
- Demonstrate the ability to construct and test series and parallel resistive circuits, series and parallel RLC circuits, half-wave and full-wave rectifiers, single stage common emitter transistor amplifier circuits and audio op-amp circuits using an op-amp, by choosing the correct measuring instruments.

7.2 Topic 2: Binary arithmetic and assembly of a computer

7.2.1 Subject Outcome 1: Demonstrate an ability to work within the binary system.

Learning Outcome

- Demonstrate ability to convert between the binary, octal and hexadecimal systems.
- Solve arithmetic operations (addition, subtraction, multiplication, division) using the binary system.
- Solve subtraction problems in the binary system by using 1's and 2's complement.

7.2.2 Subject Outcome 2: Demonstrate an ability to assemble and boot a computer.

Learning Outcome

- Demonstrate an ability to assemble a personal computer by connecting components to the motherboard and the power supply to the point where the computer is bootable.
- Explain how to troubleshoot hardware faults on a computer.

7.3 Topic 3: Introduction to ladder logic as used in PLCs

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

Range: Level, pressure, velocity and flow.

Learning Outcome

- Recognise and name mechanical instruments that will measure the physical conditions in the range.
- Describe the construction and basic operation of the instruments in Subject Outcome 1.1.
- Identify how these instruments can be modified to act as sensors for an electronic controller.

7.3.2 Subject Outcome 2: Demonstrate a basic knowledge of PLCs.

Learning Outcome

- Recognise the schematic symbols used in ladder logic diagrams.
- Sketch the schematic symbols used in ladder logic diagrams.
- Indicate how a given simple ladder logic diagram would function.
- Predict the end result of a given simple ladder logic diagram.

8 RESOURCE NEEDS FOR THE TEACHING OF ELECTRONIC CONTROL AND DIGITAL ELECTRONICS – LEVEL 3

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. `