SAQCC FIRE

D&GS TRAINING SUB COMMITTEE

COURSE CURRICULUM

COURSE	**Electrical and Electronic theory**	
ORIGINATOR	**Shane Nefdt**	
DATE	22nd May 2013	
Amendment 1	05th October 2013	Change "student" to "learner"
Amendment 2	06th October 2013	Word change
Issued	30th October 2013	Issued

EQUIVALENT TRAINING COURSES AVAILABLE		
TITLE	TRAINING SCHOOL	CONTACT DETAILS
None to our knowledge		

STATUS OF CURRICULUM - Complete - Issued

EQUIVALENT UNIT STANDARD

None to our knowledge

PURPOSE OF TRAINING COURSE

This subject covers the basics of electrical and electronic principles and practice; it is assumed that learners have no previous electrical background and knowledge.

Electrical and electronic Principles and Practice transfers trade specific skills, knowledge, values and attitudes so that learners can explain how electricity and electronics is applied in practice.

Electrical and electronic theory covers the basic electrical theory and an introduction to the basic theoretical component knowledge of Electronics.

The purpose of including this subject is not to produce learners who are electrical or electronic experts but to familiarise the student with basic circuitry to enable them to understand operation of fire detection systems better.

LEARNING ASSUMED TO BE IN PLACE

ABET 3 in Literacy

Cabling and conduit

Safety and Workshop practice

OUTCOMES REQUIRED

Topics Covered:

ELECTRICAL

1. SI Units of Measurement
2. Electric and Magnetic Theories
3. DC and AC Circuits
4. Protection and Measuring and Testing Instruments

ELECTRONIC

5. Components and Circuit Drawings
6. Digital Electronics

Assessments take on the form of written tests using various strategies and practical activities to evaluate and provide feedback to the attendee and employer alike.

1. SI UNITS OF MEASUREMENT

Outcome 1: Recognise and use basic SI units of measurement

Learning Outcomes:

The learner should be able to:

- Identify basic units of measurement used in engineering.
- Define the physical quantities that are measured by the SI units.
- Describe the rules when writing SI units of measurement.
- Convert scientific notation to decimal notation and vice versa (Convert answer to 3 decimal digits).

- List common prefixes used in engineering.
- Derive new units from the relationships between the SI units (i.e. the quantities they measure). The *range includes: Resistance and electrical terms.*

Assessment:

- Written test and assignments on basic SI units of measurements
- Written test and assignments on conversions of SI units
- Written assignments on new units.

2. ELECTRIC AND MAGNETIC THEORIES

Outcome 1: Explain fundamental concepts and basic principles of electricity

Learning Outcomes:

The learner should be able to:

- Explain the fundamental concepts and terms used in electricity.
  The range includes: conductors and insulators, potential difference, electromotive force, resistance and Ohm's law.
- Explain the units of measurement of electric entities.
  The range includes: Potential difference, electromotive force, resistance, power and energy.
- Explain, with an illustration, the relationship between electrical entities using a series circuit containing a battery, switch and resistive component.

Assessment:

- Written tests to assess whether the important definitions, conventions, analogies, symbols, units of measurements and concepts used in fundamental electrical theory have been retained.
- Demonstrations used to prove theoretical statements.
- Practical experiments to compare results with theoretical statements.

Outcome 2: Perform calculations using Ohm's law

Learning Outcomes:

The learner should be able to:

- Explain what Ohm's law is and identify the formula used for calculations.
- Perform calculations on resistance using the correct formulae and units of measurement (SI units).

Assessment:

- Learners to recognise and correctly use formulae to calculate voltage, current, resistance. (Converted to standard units of measurement.)

Outcome 3: Explain the factors influencing the electrical resistance of materials and perform calculations

Learning Outcomes:

The learner should be able to:

- Describe, with examples, electrical conductors and the types of material commonly used to manufacture it.
- List and explain, with examples, factors affecting electrical resistance (material, shape, size, length, and area or cross sectional area, temperature).
- Perform calculations to determine resistance.

Assessment:

- Written tests to assess whether information and concepts have been retained.
- Calculations are performed to calculate resistance
- Learners to identify and explain samples of conductors.

Outcome 4: Compare different electrical supply systems

The range includes:

- Direct current (DC),
- Alternating current (AC),
- Single and three phase AC supply systems.

Learning Outcomes:

The learner should be able to:

- Explain, with examples, the difference between direct current (DC) and alternating current (AC).
- Explain, with examples, the following electrical supply systems:
  - *Single phase supply systems*
  - *Three phase supply systems.*

Assessment:

- Test for understanding of concepts such as DC, AC, single phase and three-phase AC supplies, amplitude, frequency, two-wire, three-wire and four-wire supply systems.

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3. DIRECT CURRENT (DC) AND ALTERNATING CURRENT (AC) CIRCUITS

Outcome 1: Explain continuity and current flow

Learning Outcomes:

The learner should be able to:

- Identify closed and open circuits from examples.
- Predict whether current flow is possible.

Assessment:

- Learner identifies closed and open circuits from examples and practical exercises.
- Learner can predict whether current flow is possible by demonstrating principle in practical exercises.

Outcome 2: Explain and perform calculations on the grouping of electrical cells

The range includes:
- Series,
- Parallel and
- Series-parallel

Learning Outcomes:

The learner should be able to:

- Explain concepts such as electrical cells, EMF of cells, internal resistance and grouping of cells.
- Perform calculations on typical circuits involving the grouping of cells using practical examples.

Assessment:

- Written tests to assess whether information and concepts have been retained.
- Calculations on resistance, current and voltage.
- Sketching/drawing of circuit diagrams using standard symbols and drawing practices.

Outcome 3: Explain electric circuits and perform calculations

Learning Outcomes:

The learner should be able to:

- Describe different electric circuit combinations.
  The range includes: series, parallel, series-parallel.
- Explain the principles of operation for a combination of resistors.
- Sketch the circuit diagrams from the information supplied, using IEC symbols.
- Use appropriate formulae to calculate voltages, total resistance and currents in all the circuit branches and volt drops across resistors.

Assessment

- Written tests to assess whether information and concepts on electrical circuits have been retained.
- Learners calculate resistance, current and voltage.
- Learners draw circuit diagrams using standard symbols and drawing practices.

4. PROTECTION, MEASURING AND TESTING INSTRUMENTS

Outcome 1: Explain the importance of earthing electrical appliances and installations (single-phase)

Learning Outcomes:

The learner should be able to:

- Explain the concept ‘earthing’ of electrical appliances and installations (single-phase) and the importance of earthing.

- Identify devices and systems which require earthing according to the SABS Code of Practice (SANS 10142).
- Explain earthing in relation to "intrinsically safe" environments.

Assessment:

- Learners explain how earthing of electrical appliances, installations and distribution systems is achieved in practice.
- Practical Task: Learners research the SABS Code of Practice 0142 for earthing requirements (SANS 10142).

Outcome 2: Identify and explain the use of electrical measuring and testing instruments

The range includes:

- Multi meters
- Meggers and wattmeters,
- Continuity testers

Learning Outcomes:

The learner should be able to:

- Sketch and explain how measuring and testing instruments are inserted in circuits.
- List the precautions when using measuring and testing instruments.
- Sketch and explain the basic design and operating principles of an insulation resistance tester.
- Explain how the range of a voltmeter and ammeter can be increased.

Assessment:

- Written test on electrical measuring and testing instruments, its operation and use.

Outcome 3: Use, care for and store hand-held electrical test instruments (tong-tester, ammeter, voltmeter, multimeter and Megger).

The range includes:

- Multi meter and
- Insulation resistance meters

Learning Outcomes:

The learner should be able to:

- Set the instruments for use.
- Select and read scaled readings from various analogue and digital instruments.
- Insert instruments correctly into circuits.
- Illustrate correct care for the instruments.
- Illustrate correct storage of the instruments

Assessment:

- Insert multi meters and ohmmeters into circuits.
- Couple current transformers and potential transformers to increase the range of the instruments.

- Read the value of the instruments.
- Correctly multiply the scale factor of the displayed value to attain the actual value.

5. COMPONENTS AND CIRCUIT DRAWINGS

Outcome 1: Identify, rate and explain the function of basic electronic components

The range includes:

- Resistors, potentiometers, capacitors (polarised and non-polarised), inductors, relays, transformers, semi conductors.

Learning Outcomes:

The learner should be able to:

- Recognise the components in the range.
- Indicate the rating of the components in the range according to their physical sizes.
- Classify the components in the range according to their functions.
- Describe the basic functions and operation of the components in the range.

Assessment:

- Components provided in the range are recognised from physical examples and written examples.

Outcome 2: Outline different types of diodes

Learning Outcomes:

The learner should be able to:

- Draw the characteristic curve of a typical diode.
- Explain the basic operation of diodes (Zener and Light Emitting Diode).
- Describe the functions and applications of diodes.
- Indicate the rating of the components by means of physical marking on them.

Assessment:

- Assessments on the operation and use of diodes and their components.
- Different types of diodes are drawn.

Outcome 3: Read and draw symbols of electronic components (elementary circuit drawings).

The range includes:

- 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)

Learning Outcomes:

The s learner should be able to:

- List the symbols of the components in the range.
- Sketch the symbols of the components in the range.
- Interpret elementary circuits.
- Sketch and label elementary circuits.

Assessment:

The symbols are recognised from sketched examples and drawn on paper or appropriate medium

6. DIGITAL ELECTRONICS

Outcome 1: Explain Number systems

Learning Outcomes:

The learner should be able to:

- Convert from binary systems to decimal systems and vice versa by means of calculations.
  The range includes: *Whole numbers only (no fractions); calculations restricted to addition and subtraction only.*
- Convert a binary number to its 1's and 2's complement.
- Demonstrate the ability to count in the binary system.
- Use a parity bit to detect error.

Assessment:

- Conversions between binary and decimal systems and vice versa are done in writing without the use of a calculator.
- An ability to count up or down in binary to a minimum of four bits is demonstrated in writing.