Unit ID: 893

Domain **FOUNDATION ENGINEERING SCIENCE AND DRAWING SKILLS**

Title: **Apply knowledge of basic engineering science in different contexts**

Level: 2 **Credits: 6**

Purpose

This unit standard specifies the competencies required to apply knowledge of basic engineering science in different context. It includes competencies to apply knowledge of drawing instruments and SI units (International System of Units), apply basic knowledge of dynamics in engineering science, apply knowledge of statics in engineering science, demonstrate knowledge of energy, work and power, outline the concept of heat and temperature, outline the concept of heat capacity and linear expansion, describe particle structure of matter, describe the basic concept of electricity including magnetism and describe factors influencing electric circuits. This unit standard is intended for people requiring basic engineering science skills as applied in different contexts.

Special Notes

1. This unit standard gives users exposure to a holistic approach of study and world of work to gain an understanding of the world as a set of related systems, by recognizing that problem solving contexts do not exist in isolation but that they may differ from context to context according to the area of application.

2. This unit standard may be assessed in any context of operation and may be assessed in conjunction with other relevant technical unit standards selected from a particular domain that has a thematic link to this unit standard.

3. Assessment evidence may be collected at any realistic place where logical collection of such evidence can be achieved.

4. The correct use of the suitable technical terminology must be stressed, especially in formulating definitions and principles.

5. $g = 9, 8\ m/s^2$ should be taken as the value for gravitational acceleration in all applicable calculations.

6. Scientific pocket calculators may be used in solving mathematical problems. Basic instruction must be offered in the practical use and operational abilities of the calculator. A comma has to be used for the decimal sign throughout calculations.

7. Regulations and legislation relevant to this unit standard include the following:
   - Labour Act, No. 11, 2007.

- Occupational Health and Safety Regulations No. 18, 1997 and all subsequent amendments.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which meet the accreditation requirements set by the Namibia Qualifications Authority and the Namibia Training Authority and which comply with the national assessment and moderation requirements. Details of specific accreditation requirements and the national assessment arrangements are available from the Namibia Qualifications Authority and the Namibia Training Authority on www.nta.com.na.

Elements and Performance Criteria

Element 1: Apply knowledge of drawing instruments and SI units.

Range

Basic drawing instruments may include but are not limited to a ruler, protractor, flexi (French) curves and divider.

Performance Criteria

1.1 Basic drawing instruments are identified.

1.2 SI units, prefixes and symbols are identified.

1.3 Drawing instruments are correctly used to produce simple drawings.

1.4 Simple calculations are performed using a scientific calculator.

Element 2: Apply basic knowledge of dynamics in engineering science.

Range

Basic formulae: *Speed=distance ÷ time (v=s ÷ t) and*
Velocity = displacement ÷time (v = s ÷ t)
Acceleration = change in velocity /change in time (a = vv ÷t)

Performance Criteria

2.1 Scalar and vector quantities are explained.

2.2 Vector additions are performed using appropriate rules and graphs.

2.3 Distance displacement, speed, velocity acceleration and time are classified as vector and scalar quantities.

2.4 Distance displacement speed velocity acceleration and time are explained in terms of their relationships to each other using formulae and graphs.

2.5 Mass and weight are explained and distinguished as either scalar or vector quantities.

2.6 Conversion between mass and weight is performed.

Element 3: Apply knowledge of statics in engineering science.

Range

Basic lifting machines may include but are not limited to simple lever, single rope pulley block systems and wheel and axle.

Performance Criteria

3.1 Force is explained in terms of its effects on a body and as a vector quantity.

3.2 Graphs are drawn to represent force in both magnitude and direction.

3.3 Triangle of forces is explained.

3.3 Addition of vectors in the same plane (equilibrium of translation) is performed using graphs.

3.4 The application of bow notation is indicated by means of a sketch (graph).

3.5 Parallelogram of forces, resultant and equilibrant forces are explained and determined graphically.

3.6 Moment of a force and the law of moment are explained and applicable calculations on moments are performed.

3.7 Application of turning moments is illustrated by means of a simple sketch and calculations.

3.8 The concept of lifting machines is explained in terms of mechanical advantage and displacement/velocity ratio.

3.9 Sketches of basic lifting machines are drawn and formulae are used to calculate mechanical advantage of each type.

3.10 The concept of efficiency is explained and applicable calculations are performed.

Element 4: Apply knowledge of energy, work and power.

Range

Forms of energy may include but are not limited to potential energy, heat energy, kinetic energy, electrical energy and chemical energy.

Formulae to calculate work and/or power: W=F x s; P=W/t and P=F x v. (restricted to motion at constant velocity and applied forces parallel to the plane only).

Performance Criteria

4.1 The term energy and different forms of energy are defined.

4.2 The law of conservation of energy is formulated.

4.3 The transformation of energy between forms of energies is explained using the law of conservation of energy.

4.4 The difference between radiation, convection and conduction is stated.

4.5 The terms work and power are defined with appropriate examples.

4.6 Graphs are used to explain and determine amount of work done.

4.7 Applicable calculations of work done and power required are performed by manipulating the appropriate formula

Element 5: Outline the concept of heat and temperature.

Performance Criteria

5.1 Terms heat and temperature are defined and the difference between them clearly distinguished.

5.2 Thermometers (alcohol and mercury) and pyrometers and their respective use are described.

5.3 The degree Celsius and Kelvin scales are compared and applicable conversions are carried out.

5.4 Propagation of heat in liquid, solid and vacuum is explained.

5.5 Effects of heat on substance are explained in case of change in temperature, change in colour, change of phase, change of composition, change of resistance and change of the origin of electric current.

Element 6: Outline the concept of heat capacity and linear expansion.

Performance Criteria

6.1 The concepts heat capacity and specific heat capacity are explained.

6.2 The principle of the transfer of heat in a body is explained in terms of loss and gain of heat.

6.3 Calculation of heat gained and heat lost is performed using and manipulating the formula $Q = m \times c \times \Delta t$.

6.4 The concept of bimetal strip and the ball and the ring are described giving practical examples.

6.5 Changes in length of objects due to temperature changes are calculated using the formulae *Final length = Original length + increase in length (temperature rise); and, Final length = Original length – decrease in length (temperature drop).*

6.6 The principle of linear expansion and contraction is explained and related calculations are performed.

Element 7: Describe particle structure of matter.

Performance Criteria

7.1 The three phases of matter are listed and examples of simple phase changes are given.

7.2 The motion of the particles in the three phases of matter is described.

7.3 The effect of heat on the motion of the particles is described in relation to changes of phase.

7.4 Model and structure of an atom is described in terms of construction of the atom taking into account the composition of the atom and charge of the nucleus and electrons.

Element 8: Describe the basic concept of electricity and magnetism.

Range

Basic circuit components may include but are not limited to fixed resistor, variable resistor, switch, cell, battery, ammeter, voltmeter and galvanometer.

Performance Criteria

8.1 The concept of conductors and insulators is explained and examples of materials for each are listed.

8.2 Basic circuit components and their symbols are identified and a simple circuit is drawn.

8.3 Electric quantities (current, potential difference and resistance) are explained.

8.4 The difference between direct and alternating currents is made using graphic examples.

8.5 Ohm’s law is used to determine unknown electric quantities.

8.6 Totals and branch totals of electric quantities are determined in circuits connected in series, parallel and series-parallel connections.

8.7 Correct connection of an ammeter and voltmeter in an electric circuit is shown using appropriate diagrams.

8.8 The field lines of permanent bar magnets, the magnetic field lines around a straight current carrying conductor and a current carrying solenoid is explained with drawings.

8.9 Fleming's right-hand rule is applied to determine the direction of the magnetic fields and of the current flow around a straight current carrying conductor and a solenoid.

8.10 Practical applications of electromagnetism, e.g. a relay switch and an electrical bell and operation thereof are explained.

Element 9: Describe factors influencing electric circuits.

Range

Factors influencing resistance may include but are not limited to the kind of metal the conductor is manufactured from (resistivity), the length of the conductor, the temperature of the conductor and the cross-sectional area.

Performance Criteria

9.1 Factors influencing the resistance of a conductor are explained and applicable calculations are performed.

9.2 The influence of a change in temperature on the resistance of pure metals (copper and silver), alloys (brass and German silver) and insulators (bakalite and polyvinyl chloride (PVC)) is described.

9.3 Resistivity of a conductor is explained and factors that determine resistivity of a substance are listed.

9.4 The effect of heat on electric current is described and applicable calculations are performed using Joule's law and formula *Heat (Q)* = I^2 *x* R x t.

9.5 An electric power circuit is described and related calculations are performed by applying and or manipulating formula P = I^{2x} x R and/or Ohm's law.

Registration Data

Subfield:	Engineering Science and Drawing
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