QUALIFICATION SPECIFICATION

Nuclear & Integrated Nuclear Engineering & Science (RQF)

ECITB Level 3 Certificate in Nuclear Engineering & Science (RQF) 603/2545/8
ECITB Level 3 Diploma in Nuclear Engineering & Science (RQF) 603/2550/1
ECITB Level 3 Diploma in Integrated Nuclear Engineering & Science (RQF) 603/2551/3

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Contents

Nuclear & Integrated Nuclear Engineering and Science (RQF)

1. Introduction

These RQF qualifications provide recognition of the knowledge, skills and behaviours of individuals looking to embark on a career in the nuclear industry sectors.

ECITB Level 3 Certificate in Nuclear Engineering & Science (RQF)
ECITB Level 3 Diploma in Nuclear Engineering & Science (RQF)
ECITB Level 3 Diploma in Integrated Nuclear Engineering & Science (RQF)

The content of these qualifications has been designed using Training Standards owned by the National College for Nuclear (NCfN).

Candidates are required to register on the Certificate or relevant Diploma prior to any assessment for the qualification.

1.1 Objective

The objective of these Engineering Construction Industry Training Board (ECITB) vocational qualifications is to provide successful candidates with recognition that they can demonstrate the knowledge, skills and behaviours required of workers in the Nuclear Sector. The ECITB Level 3 Diploma in Integrated Nuclear Engineering & Science (RQF) also provides an alternative entry route for a level 5 apprenticeship in the field of Nuclear Engineering & Science with the Nuclear Technician Standard ST0380. The qualifications are officially recognised by the NCfN.

1.2 Entry recommendations

There are no mandatory entry requirements. However, due to the level and complexity of the subject, it is recommended that candidates should have attained five GSCE grade ‘‘C’/’5’ or above in subjects including Mathematics, English and Science or be able to demonstrate evidence of other suitable attainment or experience. A candidate’s individual circumstances will determine which qualification is most appropriate to them and the Approved Centre will work with the prospective candidate to determine eligibility for a qualification.

1.3 Achievement

To be awarded an ECITB Level 3 Certificate or Diploma in Nuclear Engineering & Science or an ECITB Level 3 Diploma in Integrated Nuclear Engineering & Science, the candidate must have achieved the minimum pass requirements for the qualification. For each qualification, candidates are required to achieve a minimum pass rate of 50% in each unit to be awarded the qualification.

1.3.1 Certificate in Nuclear Engineering & Science

MANDATORY UNITS - candidates must achieve both units:

NES 01 Introduction to Nuclear Science and the Nuclear Industry
NES 02 Fundamentals of Mathematics for Nuclear Engineering & Science

OPTIONAL UNITS – candidates must achieve units totalling a minimum of 110 hours TQT:

NES 03 Fundamentals of Physical Chemistry for Nuclear
OR
NES 04 Fundamentals of Electrical Science for Nuclear
NES 05 Fundamentals of Mechanical Science for Nuclear

1.3.2 Diploma in Nuclear Engineering & Science

MANDATORY UNITS - candidates must achieve all 4 units:

NES 01 Introduction to Nuclear Science and the Nuclear Industry
NES 02 Fundamentals of Mathematics for Nuclear Engineering & Science
NES 06 Fundamentals of Study, Report Writing and Presentation Skills
NES 12 Introduction to Radiological Protection, Detection and Monitoring

OPTIONAL UNITS – candidates must achieve a minimum of THREE of the following units totalling a minimum of 200 TQT:

NES 03 Fundamentals of Physical Chemistry for Nuclear
NES 04 Fundamentals of Electrical Science for Nuclear
NES 05 Fundamentals of Mechanical Science for Nuclear
NES 07 Introduction to Inorganic and Organic Chemistry for Nuclear
NES 08 Introduction to Instrumentation for Nuclear
NES 09 Introduction to Control Systems for Nuclear
NES 10 Chemistry for Nuclear - Practical
NES 11 Engineering Science for Nuclear - Practical

1.3.3 Diploma in Integrated Nuclear Engineering & Science

MANDATORY UNITS - candidates must achieve all 12 units:

NES 01 Introduction to Nuclear Science and the Nuclear Industry
NES 02 Fundamentals of Mathematics for Nuclear Engineering & Science
NES 03 Fundamentals of Physical Chemistry for Nuclear
NES 04 Fundamentals of Electrical Science for Nuclear
NES 05 Fundamentals of Mechanical Science for Nuclear
NES 06 Fundamentals of Study, Report Writing and Presentation Skills
NES 07 Introduction to Inorganic and Organic Chemistry for Nuclear
NES 08 Introduction to Instrumentation for Nuclear
NES 09 Introduction to Control Systems for Nuclear

NES 10 Chemistry for Nuclear - Practical
NES 11 Engineering Science for Nuclear - Practical
NES 12 Introduction to Radiological Protection, Detection and Monitoring

1.4 Assessment

These qualifications can only be delivered by ECITB Approved Centres who are also approved for associated course delivery by the NCfN.

The candidate must successfully complete all units as outlined in the applicable qualification structures detailed in section 1.3.

Assessment is by a combination of written (or equivalent*) assignments; practical assignments; and written timed assignments.

*Written assignment equivalent assessment allows the candidate to be assessed through the provision of evidence required for the set assessment in a format other than a traditional written format. Evidence must demonstrate it is the authentic work of the candidate.

Acceptable equivalence assessment evidence examples;

- Presentations with assessor or peer questioning
- Professional discussion
- Working logbooks
- Video Blogs
- Reflective journals

Evidence can be captured through recordings, photographs, observation or task sheets.

1.5 Total Qualification Time (TQT), level and duration of qualification

1.5.1 ECITB Level 3 Certificate in Nuclear Engineering & Science (RQF)

The TQT for this Certificate is 220 hours. The duration of this qualification is Part Time, one term. The TQT is broken down by unit below:

Unit	Guided Learning	Total Qualification Time
Mandatory Units		
NES 01 Introduction to Nuclear Science and the Nuclear Industry	40	55
NES 02 Fundamentals of Mathematics for Nuclear Engineering & Science	40	55
Optional Units:		
NES 03 Fundamentals of Physical Chemistry for Nuclear	80	110
OR		
NES 04 Fundamentals of Electrical Science for Nuclear	40	55
NES 05 Fundamentals of Mechanical Science for Nuclear	40	55

1.5.2 ECITB Level 3 Diploma in Nuclear Engineering & Science (RQF)

The minimum TQT for this Diploma is 410 hours. The duration of this qualification is Full Time, one term. The TQT is broken down by unit below:

Unit	Guided Learning	Total Qualification Time
Mandatory Units		
NES 01 Introduction to Nuclear Science and the Nuclear Industry	40	55
NES 02 Fundamentals of Mathematics for Nuclear Engineering & Science	40	55
NES 06 Fundamentals of Study, Report Writing and Presentation Skills	40	45
NES 12 Introduction to Radiological Protection, Detection and Monitoring	40	55
Optional Units: **Optional units must meet 200 TQT (minimum 3 units)**		
NES 03 Fundamentals of Physical Chemistry for Nuclear	80	110
NES 04 Fundamentals of Electrical Science for Nuclear	40	55
NES 05 Fundamentals of Mechanical Science for Nuclear	40	55
NES 07 Introduction to Inorganic and Organic Chemistry for Nuclear	80	110
NES 08 Introduction to Instrumentation for Nuclear	40	55
NES 09 Introduction to Control Systems for Nuclear	40	55
NES 10 Chemistry for Nuclear – Practical	40	45
NES 11 Engineering Science for Nuclear – Practical	40	45

1.5.3 ECITB Level 3 Diploma in Integrated Nuclear Engineering & Science (RQF)

The TQT for this Diploma is 740 hours. The duration of this qualification is Full Time, two terms. The TQT is broken down by unit below:

Unit	Guided Learning	Total Qualification Time
Mandatory Units		

NES 01 Introduction to Nuclear Science and the Nuclear Industry	40	55
NES 02 Fundamentals of Mathematics for Nuclear Engineering & Science	40	55
NES 03 Fundamentals of Physical Chemistry for Nuclear	80	110
NES 04 Fundamentals of Electrical Science for Nuclear	40	55
NES 05 Fundamentals of Mechanical Science for Nuclear	40	55
NES 06 Fundamentals of Study, Report Writing and Presentation Skills	40	45
NES 07 Introduction to Inorganic and Organic Chemistry	80	110
NES 08 Introduction to Instrumentation for Nuclear	40	55
NES 09 Introduction to Control Systems for Nuclear	40	55
NES 10 Chemistry for Nuclear - Practical	40	45
NES 11 Engineering Science for Nuclear - Practical	40	45
NES 12 Introduction to Radiological Protection, Detection and Monitoring	40	55

2. Qualification units and scope of assessment

2.1 Units

Unit NES 01 Introduction to Nuclear Science and the Nuclear Industry

Learning outcomes for this unit:

The candidate will understand:

1. The history, lifecycle and structure of the UK nuclear industry
2. Safety and security requirements and standards within the UK nuclear industry
3. The structure of the atom and be able to define key terms associated with atomic structure and the use of the periodic table
4. Radiation types, decay mechanisms, detection and the interactions with matter
5. Types of radiological hazard, the methods of minimising risk and the analysis of the effects of radiological interaction
6. Fission and the relationship with radioactive materials and nuclear reactors.

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. THE HISTORY, LIFECYCLE AND STRUCTURE OF THE UK NUCLEAR INDUSTRY

1.1 Describe the evolution of the UK's nuclear programme
1.2 Describe the nuclear lifecycle

2. SAFETY AND SECURITY REQUIREMENTS WITHIN THE UK NUCLEAR INDUSTRY

2.1 Describe the safety requirements in the nuclear industry and security structure within the nuclear industry
2.2 Describe the Standards in the global nuclear industry

3. STRUCTURE OF THE ATOM AND KEY TERMS ASSOCIATED WITH ATOMIC STRUCTURE AND THE PERIODIC TABLE

3.1 Describe atomic structure
3.2 Describe key terms associated with atomic structure

4. RADIATION TYPES, DECAY MECHANISMS, DETECTION AND INTERACTIONS WITH MATTER

4.1 Explain the different types of ionising and non-ionising radiation
4.2 Describe the operation and use of common radiation detection and measurement systems

5. HAZARDS OF RADIATION AND THE EFFECTS OF SUCH INTERACTIONS

5.1 Describe common radiation hazards and the impact of such hazards on the human body
5.2 Describe methods for minimising radiation risk

6. FISSION AND THE RELATIONSHIP WITH RADIOACTIVE MATERIALS AND NUCLEAR REACTORS

6.1 Describe the fission process within a nuclear reactor
6.2 Describe the types of nuclear reactor

Unit NES 02 Fundamentals of Mathematics for Nuclear Engineering & Science

Learning outcomes for this unit:

The candidate will understand:

1. The use of number systems and the process of transposing equations and solving linear and quadratic equations
2. Trigonometric functions and the calculation of angles and lengths using trigonometry
3. The application of functions and graphs to Nuclear Engineering and Science problems
4. The collation of data and the identification of important statistical characteristics of a data set
5. The use of differential and integral calculus within engineering and science
6. The application of mathematics to nuclear engineering and science activities

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. NUMBER SYSTEMS, LINEAR AND QUADRATIC EQUATIONS IN A NUCLEAR CONTEXT

1.1 How to use number systems within a nuclear context
1.2 How to rearrange formulae and transpose and solve linear equations associated with nuclear science and engineering principles
1.3 How to create and solve pairs of linear simultaneous equations with an engineering and science context
1.4 How to factorise and solve quadratic equations
1.5 How to combine algebraic fractions

2. TRIGONOMETRIC FUNCTIONS AND THE CALCULATIONS OF ANGLES AND LENGTHS

2.1 How to use trigonometric functions and identities

3. THE APPLICATION OF FUNCTIONS AND GRAPHS TO NUCLEAR ENGINEERING AND SCIENCE PROBLEMS

3.1 How to describe functions through graphs
3.2 How to use graphs and functions to solve nuclear science and engineering problems

4. COLLATION OF DATA AND IDENTIFICATION OF STATISTICAL CHARACTERISTICS OF A DATA SET

4.1 How to describe the principles of data collection

4.2 Carry out statistical analysis of collected data

5. THE USE OF DIFFERENTIAL AND INTEGRAL CALCULUS WITHIN ENGINEERING AND SCIENCE

5.1 Solve engineering and science problems using differential and integral calculus

6. THE APPLICATION OF MATHEMATICS TO NUCLEAR ENGINEERING AND SCIENCE ACTIVITIES

6.1 How to use nuclear and engineering case studies to enhance knowledge of the application of mathematics

Unit NES 03 Fundamentals of Physical Chemistry for Nuclear

Learning outcomes for this unit:

The candidate will understand the:

1. Structure of matter, properties of matter and volumetric analysis
2. Principles of thermo-chemistry, energy changes, chemical equilibrium and applications of industrial processes
3. Principles of acids/bases, terminology and the processes of Redox Chemistry
4. Principles and applications of electrochemistry as they relate to the nuclear sector
5. Principles of kinetics and the determination of reaction rates

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. THE STRUCTURE AND PROPERTIES OF MATTER AND VOLUMETRIC ANALYSIS

1.1 Describe the structure and properties of matter
1.2 Describe the structure and use of chemical formulae and balance
1.3 Undertake chemical analysis

2. THE PRINCIPLES OF THERMO-CHEMISTRY, ENERGY CHANGES, CHEMICAL EQUILIBRIUM AND APPLICATIONS OF INDUSTRIAL PROCESSES

2.1 Explain the fundamental principles and processes involved with energy transfer
2.2 Explain the fundamental principles of chemical equilibrium

3. THE PRINCIPLES OF ACIDS/BASES, TERMINOLOGY AND THE PROCESSES OF REDOX CHEMISTRY

3.1 Describe the principles of acids and bases
3.2 Describe the principles of Redox chemistry

4. THE PRINCIPLES AND APPLICATIONS OF ELECTROCHEMISTRY

4.1 Explain the principles of electrochemistry
4.2 Describe applications of electrochemistry in the nuclear industry

5. THE PRINCIPLES OF KINETICS AND THE DETERMINATION OF REACTION RATES

5.1 Describe methods for determining a reaction rate

Unit NES 04 Fundamentals of Electrical Science for Nuclear

Learning outcomes for this unit:

The candidate will:

1. Be able to describe the main components within a DC circuit and the application of circuit theory to determine voltage, current and resistance in direct current (DC) circuits
2. Understand the concepts of electrostatics and the calculation and measurement of relevant values in DC circuits
3. Understand the principles, properties and applications of magnetism in the context of a nuclear installation
4. Understand the principles of single-phase alternating current (AC) theory and the experimental methods for measuring relevant AC values

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. THE MAIN COMPONENTS WITHIN A DIRECT CURRENT (DC) CIRCUIT, APPLICATION OF CIRCUIT THEORY TO DETERMINE VOLTAGE, CURRENT AND RESISTANCE IN DC CIRCUITS

1.1 The main components, variables and units associated with DC circuits
1.2 How to calculate values of current, voltage and resistance within different configurations of series and parallel DC circuits
1.3 How to carry out experiments safely using relevant test equipment to measure values of current, voltage and resistance within different configurations of series and parallel DC circuits

2. CONCEPTS OF ELECTROSTATICS AND THE CALCULATION AND MEASUREMENT OF RELEVANT VALUES IN DC CIRCUITS

2.1 The operation and construction of a variety of capacitor types
2.2 How to calculate total capacitance, charge, current and voltage within a DC circuit
2.3 How to measure total capacitance, charge, current and voltage within a DC circuit
2.4 How to measure DC transient values in a series RC circuit

3. PRINCIPLES, PROPERTIES AND APPLICATIONS OF MAGNETISM

3.1 The principles, properties and units of electro-magnetism
3.2 The applications of electro-magnetism

4. PRINCIPLES OF SINGLE-PHASE AC THEORY AND METHODS FOR MEASURING AC VALUES

4.1 The principles of single phase AC theory

4.2 How to carry out experiments on series AC circuits

Unit NES 05 Fundamentals of Mechanical Science for Nuclear

Learning outcomes for this unit:

The candidate will understand the:

1. Use of common mechanical SI units and common engineering components
2. Principles of static behaviour of mechanical systems in terms of coplanar forces and simple supported beams
3. Principles of dynamic behaviour of mechanical systems in terms of equations of motion and systems in motion
4. Basic parameters of heat transfer, the methods for measuring relevant heat transfer variables and the application of heat transfer

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. COMMON MECHANICAL SI UNITS AND COMMON ENGINEERING COMPONENTS

1.1 Explain and use common SI units and orders of magnitude utilised within mechanical science
1.2 Describe and use common engineering components within mechanical science

2. PRINCIPLES OF STATIC BEHAVIOUR OF MECHANICAL SYSTEMS IN TERMS OF COPLANAR FORCES AND SIMPLE SUPPORTED BEAMS

2.1 Describe the principles of concurrent coplanar force systems
2.2 Describe the principles of simple supported beams

3. PRINCIPLES OF DYNAMIC BEHAVIOUR OF MECHANICAL SYSTEMS IN TERMS OF EQUATIONS OF MOTION AND SYSTEMS IN MOTION

3.1 Define and apply the equations of motion
3.2 Describe the concepts of work, power and energy with respect to systems in motion

4. BASIC PARAMETERS OF HEAT TRANSFER, THE METHODS FOR MEASURING RELEVANT HEAT TRANSFER VARIABLES AND THE APPLICATION OF HEAT TRANSFER

4.1 Describe the relationships between heat and temperature and the modes of heat transfer
4.2 Carry out experiments on heat transfer using temperature measurement and heat transfer devices
4.3 Explain the purpose of a heat exchanger and condenser within a nuclear reactor, including the application of the Rankine cycle within a nuclear reactor

4.4	Explain the purpose of a steam turbine to create energy transfer within a nuclear reactor

Unit NES 06 Fundamentals of Study, Report Writing and Presentations Skills

Learning outcomes for this unit:

The candidate will understand how:

1. Learning can be enhanced through the use of appropriate study skill techniques such as planning, good note taking and revision methods
2. To develop, structure and write good technical reports
3. To plan, produce and deliver presentations to a range of audiences

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. STUDY SKILLS

1.1 Organise time for study
1.2 Employ practical learning methods and note taking

2. REPORT WRITING SKILLS

2.1 Appreciate the importance of considering certain elements in order to produce a good report
2.2 Describe the structure and stages required to produce a good report
2.3 Write a good report

3. PRESENTATION SKILLS

3.1 Plan a presentation
3.2 Produce a coherent structured presentation
3.3 Deliver a confident presentation

Unit NES 07 Introduction to Inorganic and Organic Chemistry for Nuclear

Learning outcomes for this unit:

The candidate will understand the:

1. Structure and configuration of atoms
2. Structure, bonding and characteristics of matter
3. Chemistry of elements and compounds important to the nuclear fuel cycle
4. Industrial applications of elements and compounds relevant to the nuclear fuel cycle
5. Basic principles of organic chemistry

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. THE STRUCTURE AND CONFIGURATION OF ATOMS

1.1 Describe the basic terminology of atomic structure
1.2 Describe the fundamental principles of quantum mechanical model of electron behaviour
1.3 Explain the electronic configuration of elements hydrogen through to krypton
1.4 Describe electron structure in relation to position in Periodic Table

2. THE STRUCTURE, BONDING AND CHARACTERISTICS OF MATTER

2.1 Describe ionic bonding
2.2 Describe the valence electron model of metallic bonding
2.3 Describe the characteristics of covalent bonds and the intermolecular forces of attraction
2.4 Explain models of covalent bonding
2.5 Describe how substances can be categorised in terms of structure

3. THE CHEMISTRY OF ELEMENTS AND COMPOUNDS IMPORTANT TO THE NUCLEAR FUEL CYCLE

3.1 Describe the chemistry associated with elements important to the nuclear fuel cycle
3.2 Describe the chemistry of hydrogen
3.3 Describe the physical properties of relevant transitional metals

4. INDUSTRIAL APPLICATIONS OF ELEMENTS AND COMPOUNDS RELEVANT TO THE NUCLEAR FUEL CYCLE

4.1 Review the industrial applications of hydrogen

5. BASIC PRINCIPLES OF ORGANIC CHEMISTRY IN A NUCLEAR CONTEXT

5.1 Appreciate that organic chemistry is a study of carbon compounds

Unit NES 08 Introduction to Instrumentation for Nuclear

Learning outcomes for this unit:

The candidate will:

1. Understand the terminology, application and block level operation and performance of measurement systems
2. Understand the operation and application of common transducers used within a nuclear environment
3. Understand the operation and the requirement of signal conditioning within a measurement system
4. Be able to calibrate a measurement system found within a nuclear environment

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. TERMINOLOGY, APPLICATION AND BLOCK LEVEL OPERATION AND PERFORMANCE OF MEASUREMENT SYSTEMS

1.1 Describe the requirement for the main components within a measurement system
1.2 Explain and use the common measurement system performance terms
1.3 Describe the application of the common Industrial Signal Standards that are used in measurement systems

2. OPERATION AND APPLICATION OF COMMON TRANSDUCERS USED WITHIN A NUCLEAR ENVIRONMENT

2.1 Describe the operation and application of level transducers
2.2 Describe the operation and application of temperature transducers
2.3 Describe the operation and application of flow transducers
2.4 Describe the operation and application of pressure transducers
2.5 Describe the operation and application of servo transducers
2.6 Describe the operation and application of nucleonic systems

3. OPERATION AND REQUIREMENTS OF SIGNAL CONDITIONING WITHIN A MEASUREMENT SYSTEM

3.1 Describe the operation and application of common signal converters found within measurement systems
3.2 Describe the operation and application of common signal processors found within measurement systems

4. CALIBRATE A MEASUREMENT SYSTEM FOUND WITHIN A NUCLEAR ENVIRONMENT

4.1 Use test equipment to assist within the calibration process of a

measurement system
4.2 Calibrate a process measurement system using appropriate methods and procedures
4.3 Calibrate a radiation detector using a known source

Unit NES 09 Introduction to Control Systems for Nuclear

Learning outcomes for this unit:

The candidate will understand:

1. The main components and characteristics of process control systems
2. Common terminology and modes of control and their effect on control system performance
3. The process of selecting and applying tuning methods to three term controllers to improve control system performance
4. The operation and specification of different types of programmable logic controller (PLCs)
5. How to write programmable logic controller programs to meet given specifications

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. MAIN COMPONENTS AND CHARACTERISTICS OF PROCESS CONTROL SYSTEMS

1.1 Describe the main components of a closed loop control system
1.2 Explain how a closed loop control system can be characterised in the form of a transfer function
1.3 Describe the functionality of a closed loop control system in terms of system characteristics and responses

2. COMMON TERMINOLOGY AND MODES OF CONTROL AND THEIR EFFECT ON CONTROL SYSTEM PERFORMANCE

2.1 Describe the operation of an ON-OFF controller using relevant terminology
2.2 Describe the operation of a three term controller using relevant terminology
2.3 Explain how the parameters of a three term controller affect the response and performance of a closed loop system
2.4 Select an appropriate controller to meet a given specification

3. THE PROCESS OF SELECTING AND APPLYING TUNING METHODS TO THREE TERM CONTROLLERS TO IMPROVE CONTROL SYSTEM PERFORMANCE

3.1 Select a method for tuning a three term controller based on the systems characteristics

3.2 Tune a controller to meet a given system response specification

4. THE OPERATION AND SPECIFICATION OF DIFFERENT TYPES OF PROGRAMMABLE LOGIC CONTROLLER (PLCS)

4.1 Describe the various types of programmable logic controller
4.2 Describe the operational characteristics, hardware and software specification of a programmable logic controller
4.3 Explain the interfacing requirements of a programmable logic controller

5. WRITING PROGRAMMABLE LOGIC CONTROLLER PROGRAMS TO MEET GIVEN SPECIFICATIONS

5.1 Use a range of PLC instructions and functions to perform a control task
5.2 Develop PLC programs to perform various operations

Unit NES 10 Chemistry for Nuclear - Practical

Learning outcomes for this unit:

The candidate will be able to:

1. Conduct chemistry laboratory work as part of a group in a safe manner
2. Plan which materials and methods will be used in a chemistry experiment
3. Prepare the work area, materials and equipment to complete chemistry laboratory work
4. Carry out chemistry laboratory work
5. Carry out the necessary actions after completing chemistry laboratory work

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. CONDUCT CHEMISTRY LABORATORY WORK AS PART OF A GROUP IN A SAFE MANNER

1.1 Work safely in a chemistry laboratory environment
1.2 Identify hazards specific to a nuclear chemistry laboratory environment
1.3 Take appropriate action to minimise the risk from hazards
1.4 Refer safety related matters to appropriate persons as required
1.5 Work in accordance with sections of the Health and Safety at Work Act and its associated regulations relevant to conducting laboratory work
1.6 Work in accordance with the requirements of risk assessments and permit to work systems

2. PLAN WHICH MATERIALS AND METHODS WILL BE USED IN A CHEMISTRY EXPERIMENT

2.1 Plan which materials to use for the experiment
2.2 Plan which methods to use for the experiment

3. PREPARE THE WORK AREA, MATERIALS AND EQUIPMENT TO COMPLETE CHEMISTRY LABORATORY WORK

3.1 Ensure that the work environment is suitable for conducting laboratory work
3.2 Ensure that equipment is suitable for conducting laboratory work
3.3 Prepare the equipment for conducting laboratory work

4. CARRY OUT CHEMISTRY LABORATORY WORK

4.1 Produce and utilise standard solutions to determine unknown concentrations
4.2 Carry out investigations to determine energy changes
4.3 Carry out experiments to investigate Le Chatelier's principles
4.4 Determine the constituents of inorganic salts

4.5 Determine the effects on pH in acid/base titrations by undertaking a range of titrations utilising a combination of strong/weak acid/bases
4.6 Explore the interaction of electrical currents and potentials on solutions
4.7 Investigate how a range of variables affect a reaction

5. CARRY OUT THE NECESSARY ACTIONS AFTER COMPLETING CHEMISTRY LABORATORY WORK

5.1 Shut down the equipment to a safe condition on completion of activities
5.2 Reinstate the work area to a safe condition
5.3 Store re-usable materials and equipment in accordance with appropriate procedures
5.4 Complete all necessary documentation

Unit NES 11 Engineering Science for Nuclear - Practical

Learning outcomes for this unit:

The candidate will be able to:

1. Conduct engineering science laboratory work as part of a group in a safe manner
2. Plan which materials and methods will be used in an engineering science experiment
3. Prepare the work area, materials and equipment to complete engineering science laboratory work
4. Carry out engineering science laboratory work
5. Carry out the necessary actions after completing engineering science laboratory work

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. CONDUCT ENGINEERING SCIENCE LABORATORY WORK AS PART OF A GROUP IN A SAFE MANNER

1.1 Work safely in an engineering science laboratory environment
1.2 Identify hazards specific to an engineering science laboratory environment
1.3 Take appropriate action to minimise the risk from hazards
1.4 Refer safety related matters to appropriate persons as required
1.5 Work in accordance with sections of the Health and Safety at Work Act and its associated regulations relevant to conducting laboratory work
1.6 Work in accordance with the requirements of risk assessments and permit to work systems

2. PLAN WHICH MATERIALS AND METHODS WILL BE USED IN AN ENGINEERING SCIENCE EXPERIMENT

2.1 Plan which materials to use for the experiment
2.2 Plan which methods to use for the experiment

3. PREPARE THE WORK AREA, MATERIALS AND EQUIPMENT TO COMPLETE ENGINEERING SCIENCE LABORATORY WORK

3.1 Ensure that the work environment is suitable for conducting laboratory work
3.2 Ensure that equipment is suitable for conducting laboratory work
3.3 Prepare the equipment for conducting laboratory work

4. CARRY OUT ENGINEERING SCIENCE LABORATORY WORK

4.1 Show practical understanding of a range of mechanical concepts

4.2 Relate mechanical theory to the behaviour of real machines and devices
4.3 Identify and safely use electrical & electronic components and test equipment
4.4 Build and test DC and AC circuits using a variety of techniques
4.5 Carry out simple fault finding on electrical / electronic circuits

5. CARRY OUT THE NECESSARY ACTIONS AFTER COMPLETING ENGINEERING SCIENCE LABORATORY WORK

5.1 Shut down the equipment to a safe condition on completion of activities
5.2 Reinstate the work area to a safe condition
5.3 Store re-usable materials and equipment in accordance with appropriate procedures
5.4 Complete all necessary documentation

Unit NES 12 Introduction to Radiological Protection, Detection and Monitoring

Learning outcomes for this unit:

The candidate will:

1. Understand the structure and sources of radiation types and associated units and definitions
2. Understand external and internal radiation hazards and methods of measurement and protection of these hazards
3. Understand the methods of controlling and monitoring radiation hazards and contamination
4. Be able to use counting monitoring and sampling equipment

Knowledge assessment criteria:

The candidate must demonstrate that they have the following knowledge:

1. STRUCTURE AND SOURCES OF RADIATION TYPES AND ASSOCIATED UNITS AND DEFINITIONS

1.1 Describe the types and properties of radiation
1.2 Explain the units used in measuring radiation and the basic operation of monitoring devices

2. EXTERNAL AND INTERNAL RADIATION HAZARDS AND METHODS OF MEASUREMENT AND PROTECTION OF THESE HAZARDS

2.1 Define sources of radiation hazard
2.2 Knowledge and definition of internal radiation hazard
2.3 Define the term dose and measurement of dose
2.4 Explain the methods and basic principles of protection

3. METHODS OF CONTROLLING AND MONITORING RADIATION HAZARDS AND CONTAMINATION

3.1 Describe the principles of controlling radiation hazards
3.2 Describe the methods of monitoring radiation hazards
3.3 Describe contamination

4. COUNTING, MONITORING AND SAMPLING EQUIPMENT

4.1 Set up and carry out experiments using counting equipment
4.2 Set up and carry out experiments using monitoring equipment
4.3 Set up and carry out experiments using air sampling equipment
4.4 Set up and carry out experiments using personal monitoring equipment