



Qualification Specification

Level 1 Diploma in Providing a Gateway to Smart Engineering

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Introduction

The aim of this qualification is to engage young people and develop their skills in science, engineering, mathematics and technology (STEM) and prepare them for an engineering career. Learners will develop the skills required to build a working robot, produce prototypes using a 3D printer, programme a microcontroller system, wire a simple cable system, design a basic pneumatic system; they will also develop work skills to demonstrate to potential employers that they are prepared for their first days at work.

Learner could progress onto further qualifications or begin a career in an engineering discipline, for example:

Electrical installations, Electrical engineering, Mechanical engineering, Engineering, Engineering maintenance, Electronics, Control engineering

The awarding organisation for this qualification is ProQual Awarding Body and the regulatory body is the Office of Qualifications and Examinations Regulation (Ofqual). The specification for these qualifications has been approved by the Welsh Government for use by centres in Wales.

Entry Requirements

There are no formal entry requirements for this qualification. Centres should carry out an **initial assessment** of candidate skills and knowledge to identify any gaps and help plan the assessment.

Qualification Profile

| | |
|-----------------------------|---|
| Qualification title | ProQual Level 1 Diploma in Providing a Gateway to Smart Engineering |
| Ofqual qualification number | 603/1140/X |
| Level | 1 |
| Total Qualification Time | 383 hours 410 glh |
| Assessment | Pass or fail Internally assessed and verified by centre staff External quality assurance by ProQual verifiers |
| Qualification start date | 1/3/17 |
| Qualification end date | |

Qualification Structure

Candidates must complete the 6 Mandatory units.

| Unit Number | Unit Title | Level | GLH |
|-------------|------------------------------|-------|-----|
| R/615/5259 | Robotics | 1 | 52 |
| J/615/5260 | Rapid Prototyping | 1 | 70 |
| L/615/5261 | Basic Programming and Coding | 1 | 52 |
| R/615/5262 | Smart Wiring Systems | 1 | 105 |
| Y/615/5263 | Utilisation of Energy | 1 | 52 |
| D/615/5264 | Skills for Work | 1 | 52 |

Centre Requirements

Centres must be approved to offer this qualification. If your centre is not approved please complete and submit form **ProQual Additional Qualification Approval Application**.

Staff

Staff delivering this qualification must be appropriately qualified and occupationally competent.

Assessors/Internal Quality Assurance

For each competence-based unit centres must be able to provide at least one assessor and one internal quality assurance verifier who are suitably qualified for the specific occupational area. Assessors and internal quality assurance verifiers for competence-based units or qualifications will normally need to hold appropriate assessor or verifier qualifications, such as:

- ProQual Level 3 Certificate in Teaching, Training and Assessing
- Award in Assessing Competence in the Work Environment
- Award in Assessing Vocationally Related Achievement
- Certificate in Assessing Vocational Achievement
- Award in the Internal Quality Assurance of Assessment Processes and Practices
- Certificate in Leading the Internal Quality Assurance of Assessment Processes and Practices

Support for Candidates

Materials produced by centres to support candidates should:

- enable them to track their achievements as they progress through the learning outcomes and assessment criteria;
- provide information on where ProQual's policies and procedures can be viewed;
- provide a means of enabling Internal and External Quality Assurance staff to authenticate evidence

Assessment

Candidates must demonstrate the level of knowledge and competence described in the unit. Assessment is the process of measuring a candidate's knowledge and understanding against the standards set in the qualification.

Each candidate is required to produce evidence which demonstrates their achievement of all of the learning outcomes and assessment criteria for each unit.

Evidence can include:

- assignments/projects/reports
- worksheets
- portfolio of evidence
- video evidence
- record of oral and/or written questioning
- candidate test papers

Learning outcomes set out what a candidate is expected to know, understand or be able to do.

Assessment criteria specify the standard a candidate must meet to show the learning outcome has been achieved.

Learning outcomes and assessment criteria for this qualification can be found from page 8 onwards.

Internal Quality Assurance

An internal quality assurance verifier confirms that assessment decisions made in centres are made by competent and qualified assessors, that they are the result of sound and fair assessment practice and that they are recorded accurately and appropriately.

Adjustments to Assessment

Adjustments to standard assessment arrangements are made on the individual needs of candidates. ProQual's Reasonable Adjustments Policy and Special Consideration Policy sets out the steps to follow when implementing reasonable adjustments and special considerations and the service that ProQual provides for some of these arrangements.

Centres should contact ProQual for further information or queries about the contents of the policy.

Results Enquiries and Appeals

All enquiries relating to assessment or other decisions should be dealt with by centres, with reference to ProQual's Enquiries and Appeals Procedures.

Certification

Candidates who demonstrate achievement of the qualification will be awarded a certificate giving the full qualification title -

ProQual Level 1 Diploma in Providing a Gateway to Smart Engineering

Claiming certificates

Centres may claim certificates for candidates who have been registered with ProQual and who have successfully achieved the required number of units for a qualification. All certificates will be issued to the centre for successful candidates.

Replacement certificates

If a replacement certificate is required a request must be made to ProQual in writing. Replacement certificates are labelled as such and are only provided when the claim has been authenticated. Refer to the Fee Schedule for details of charges for replacement certificates.

Learning Outcomes and Assessment Criteria

Unit R/615/5259 Robotics

| Learning Outcomes – the learner will | Assessment Criteria – the learner can |
|--|--|
| 1 Know about energy changes and transfers | 1.1 Describe the role of levers in energy changes and transfers |
| | 1.2 Identify levers in systems |
| 2 Know different types of force arising from the interaction between two objects | 2.1 Describe different types of force as pushes or pulls |
| | 2.2 Identify where forces are needed to cause objects to top or start moving |
| 3 Be able to carry out simple number calculations | 3.1 Use standard units of: <ul style="list-style-type: none">• mass• time• length in calculations |
| | 3.2 Use numbers: <ul style="list-style-type: none">• positive• negative• decimal in calculations relating to position and velocity |
| | 3.3 Use simple mathematical formulae in calculations |
| | 3.4 Use scale and ratio in calculations |
| 4 Be able to make accurate observations and measurements | 4.1 Formulate and ask relevant questions based on observations |
| | 4.2 Use knowledge and understanding to make predictions |
| | 4.3 Demonstrate awareness of health and safety |
| | 4.4 Make and record observations and measurements |
| 5 Know how to build a robot to given specifications | 5.1 Design and build a robot |
| | 5.2 Program the robot to perform simple actions |
| | 5.3 Demonstrate the working robot to an audience |

Assessment

There must be valid, authentic and sufficient for all the assessment criteria. However, one piece of evidence may be used to meet the requirements of more than one learning outcome or assessment criterion.

Unit J/615/5260 Rapid Prototyping

| Learning Outcomes – the learner will | Assessment Criteria – the learner can |
|--|---|
| 1 Understand what orthographic and isometric projections represent | 1.1 Sketch components in an orthographic projection from simple isometric drawings |
| | 1.2 Sketch components in isometric projection from simple orthographic drawings |
| 2 Use a Computer Aided Drawing (CAD) system to produce components | 2.1 Conduct a risk assessment on the use of a CAD system |
| | 2.2 Use a CAD package to produce a dimensioned orthographic component |
| | 2.3 Use a CAD package to produce a 3D model of a simple component |
| | 2.4 Demonstrate the effective use and maintenance of CAD files |
| 3 Use a 3D printer to produce a prototype | 3.1 Conduct a risk assessment on the use of a 3D printer |
| | 3.2 Set up the 3D printer, load print material and carry out pre-use checks |
| | 3.3 Use and monitor a 3D printer to produce a prototype from a suitable format file |
| | 3.4 Clean printer after use, including preventative maintenance if required |
| 4 Be able to work in a team | 4.1 Discuss team goals |
| | 4.2 Agree tasks for all team members |
| | 4.3 Design or modify a prototype of a simple assembly to given requirements |
| | 4.4 Working with team to produce the prototype |

Assessment

There must be valid, authentic and sufficient for all the assessment criteria. However, one piece of evidence may be used to meet the requirements of more than one learning outcome or assessment criterion.

Unit L/615/5261

Basic Programming and Coding

| Learning Outcomes – the learner will | Assessment Criteria – the learner can |
|--|--|
| 1 Know the function of basic LOGIC elements in programming | 1.1 State the function of basic LOGIC elements: <ul style="list-style-type: none">• AND• OR• NOT |
| | 1.2 Identify the common symbols used for LOGIC elements |
| | 1.3 Create truth tables for basic LOGIC elements |
| 2 Be able to create a flow chart for a simple programming process | 2.1 Create a flow chart including: <ul style="list-style-type: none">• Start/stop• Process• decision |
| | 2.2 Identify the common symbols used in flow charts |
| | 2.3 Use the common symbols within a flow chart for a given process |
| 3 Understand different number systems | 3.1 Identify different number systems: <ul style="list-style-type: none">• DECIMAL• BINARY• HEXADECIMAL |
| | 3.2 Convert two digit DECIMAL numbers to BINARY numbers |
| | 3.3 Give an example of the application of a number conversion |
| 4 Understand the function of the basic blocks of a microcontroller | 4.1 State the function of the basic blocks of a microcontroller: <ul style="list-style-type: none">• Memory• Input/Output• Process• Communication bus |
| | 4.2 State the overall function or purpose of the basic blocks within a microcontroller |
| 5 Be able to state the purpose of input and output devices | 5.1 State the purpose of: <ul style="list-style-type: none">• Heat• Light• Sound• Movement as input devices |

- 5.2 Identify a typical application for a range of input devices
- 5.3 State the purpose of:
 - lamps
 - sounders
 - motors
 - solenoids
 as output devices
- 6.2 Identify a typical application for a range of output devices
- 7 Understand the need for digital to analogue and analogue to digital conversion
 - 7.1 State the need for:
 - Digital to Analogue
 - Analogue to Digital conversion
 - 7.2 State the nature of:
 - Digital
 - Analogue
 signals
 - 7.3 Identify the need for a microcontroller to be able to communicate with the outside world
 - 7.4 Identify typical applications of:
 - Digital to Analogue
 - Analogue to Digital conversion in everyday items
- 8 Know how to create program code to carry out simple tasks
 - 8.1 Demonstrate the use of flow charts
 - 8.2 Demonstrate the use of program diagrams
 - 8.3 Create program code for a given microcontroller system that uses manual buttons or other methods for starting and stopping a motor
 - 8.4 Create program code for a given microcontroller system that controls at least three lamps in a given sequence
 - 8.5 Create program code for a given microcontroller system that monitors whether or not seat belts are being worn
 - 8.6 Create program code for a given microcontroller system that controls a door automatically
 - 8.7 Demonstrate each of the above programs on a simulator

- 8.8 Demonstrate each of the above programs on a physical system
- 8.9 Store and back up all of the programs in an appropriate retrieval system

Assessment

There must be valid, authentic and sufficient for all the assessment criteria. However, one piece of evidence may be used to meet the requirements of more than one learning outcome or assessment criterion.

Unit R/615/5262

Smart Wiring Systems

| Learning Outcomes – the learner will | Assessment Criteria – the learner can |
|--|---|
| 1 Be able to recommend a lighting system for a domestic installation | 1.1 Research and select a method of installing a domestic lighting circuit |
| | 1.2 Present research findings, including costs |
| 2 Know how to wire and test a lighting circuit | 2.1 Form and assemble a surface mounted lighting circuit |
| | 2.2 Surface mount accessories: <ul style="list-style-type: none"> • plumb and square • to +/- 5mm tolerance of a given layout diagram |
| | 2.3 Wire the circuit in line with a wiring diagram |
| | 2.4 Strip and terminate cable accessories |
| | 2.5 Select and install a suitably rated circuit breaker |
| | 2.6 Conduct a basic continuity and insulation resistance test |
| | 2.7 Record test result |
| | 2.8 Identify costs for parts and labour for the task |
| 3 Know how to conduct a maintenance activity on a lighting circuit | 3.1 Produce a risk assessment for replacing a lighting circuit accessory |
| | 3.2 Demonstrate a safe isolation procedure |
| | 3.3 Replace an accessory |
| | 3.4 Conduct a continuity and insulation resistance test |
| | 3.5 Record test result |
| 4 Understand the use of smart technologies in a lighting circuit | 4.1 Present a recommendation for a smart technology to be retrospectively added to an existing lighting circuit to allow remote control operation, to include details of research and costs of parts and labour for the tasks |
| | 4.2 Install a smart technology retrospectively to an existing lighting circuit to allow remote control operation |
| 5 Be able to recommend a socket circuit for a domestic installation | 5.1 Research and select a method of installing a domestic socket circuit |

| | |
|--|--|
| 6 Know how to wire and test a socket circuit | <p>5.2 Present research findings, including costs</p> <p>6.1 Form and assemble a surface mounted socket circuit</p> <p>6.2 Surface mount accessories:</p> <ul style="list-style-type: none"> • plumb and square • to +/- 5mm tolerance of a given layout diagram <p>6.3 Wire the system in line with a wiring diagram</p> <p>6.4 Strip and terminate cables to accessories</p> <p>6.5 Select and install a suitably rated circuit breaker</p> <p>6.6 Conduct a continuity and insulation resistance test</p> <p>6.7 Record test result</p> <p>6.8 Identify costs for parts and labour for the task</p> |
| 7 Know how to conduct a maintenance activity on a socket circuit | <p>7.1 Produce a risk assessment for replacing a socket circuit accessory</p> <p>7.2 Demonstrate a safe isolation procedure</p> <p>7.3 Replace an accessory</p> <p>7.4 Conduct a continuity and insulation resistance test</p> <p>7.5 Record test results</p> |
| 8 Understand the use of smart technologies in socket circuits | <p>8.1 Present a recommendation for a smart technology to be retrospectively added to an existing socket circuit to allow remote control operation to include details of research and costs of parts and labour for the task</p> <p>8.2 Install a smart technology retrospectively to an existing socket circuit to allow remote control operation</p> |
| 9 Understand the use of wireless alarm systems | <p>9.1 Present a recommendation for a one wireless intruder alarm system; include details of research and costs for the task</p> <p>9.2 Install a 2-zone wireless intruder alarm system</p> <p>9.3 Conduct a commissioning test</p> <p>9.4 Record results of the test</p> |

- 9.5 Conduct the handover procedure, to include an explanation of the day to day use of the system

Assessment

There must be valid, authentic and sufficient for all the assessment criteria. However, one piece of evidence may be used to meet the requirements of more than one learning outcome or assessment criterion.

Unit Y/615/5263 Utilisation of Energy

| Learning Outcomes – the learner will | Assessment Criteria – the learner can |
|---|---|
| 1 Understand the application of gears for increasing and decreasing speed | 1.1 Identify the current existing applications of gears used to: <ul style="list-style-type: none"> a) increase b) decrease speed 1.2 Construct working examples to demonstrate research findings 1.3 Describe the relationship between: <ul style="list-style-type: none"> a) torque and the increase of speed b) torque and the decrease of speed using gears |
| 2 Understand different types of energy | 2.1 Describe the following types of energy: <ul style="list-style-type: none"> • wind • gravitational • solar (light) • kinetic • potential • chemical • electrical • thermal |
| 3 Understand how different types of energy can be converted into different type of energy | 3.1 Present findings of research into how THREE of the following types of energy can be converted into a different type of energy: <ul style="list-style-type: none"> • wind • gravitational • solar (light) • kinetic • potential • chemical • electrical • thermal 3.2 Construct working examples to demonstrate THREE of the following energy conversions: <ul style="list-style-type: none"> • wind to kinetic • wind to electrical • solar to wind • solar to kinetic • gravity to kinetic |

- gravity to electrical
 - gravity to wind
 - gravity to sound
 - kinetic to electrical
 - kinetic to wind
 - thermal to kinetic
- 3.3 Present their working examples, describing the construction and performance of the examples
- 3.4 Define the following mechanical terms:
- input power
 - output power
 - efficiency
 - losses
- 4 Understand which components make up a pneumatic system
- 4.1 Describe the following pneumatic components:
- compressor
 - receiver
 - tubing
 - manual valve
 - single acting cylinder
 - double acting cylinder
 - pressure gauge
- 4.2 Design a basic pneumatic system to include:
- compressor
 - receiver
 - tubing
 - manual valve
 - single or double acting cylinder
 - pressure gauge
- 4.3 Research examples of pneumatic systems already utilised
- 4.4 Present their findings
- 5 Construct pneumatic systems
- 5.1 Construct a basic pneumatic system to include: compressor, receiver, tubing, manual valve, single or double acting cylinder, pressure gauge
- 5.2 Construct two pneumatic systems each with a practical application to include: compressor, receiver, tubing, manual valve, single or double acting cylinder, pressure gauge

- 5.3 Present a report describing TWO pneumatic systems each with a practical application, which include the following:
- compressor
 - receiver
 - tubing
 - manual valve
 - single or double acting cylinder
 - pressure gauge

Assessment

There must be valid, authentic and sufficient for all the assessment criteria. However, one piece of evidence may be used to meet the requirements of more than one learning outcome or assessment criterion.

Unit D/615/5264

Skills for Work

| Learning Outcomes – the learner will | Assessment Criteria – the learner can |
|--|--|
| 1 Understand the need for effective workplace communication skills | 1.1 Identify SIX different types of written and oral communication |
| | 1.2 Know the importance of: <ul style="list-style-type: none"> • effective written and verbal communication • team working in the workplace |
| | 1.3 Demonstrate effective communication skills |
| 2 Understand the skills that employers are looking for | 2.1 Identify their own: <ul style="list-style-type: none"> • skills • achievements • strengths • areas for development |
| | 2.2 Identify the skills that employers are looking for |
| | 2.3 State the importance of: <ul style="list-style-type: none"> • personal presentation • timekeeping • communication • health and safety in the workplace |
| 3 Know how to create a simple budget | 3.1 Draw up a budget plan to manage personal work-related expenses over a one month period |
| | 3.2 Identify what must be shown on a pay slip |
| | 3.3 Identify what all pay deductions represent |
| 3 Be able to deliver a presentation to an audience | 3.1 Identify a topic for a presentation |
| | 3.2 Prepare a presentation |
| | 3.3 Demonstrate effective communication skills through the delivery of their presentation |
| 4 Be able to manage online information storage | 4.1 Organise and store information on line |
| | 4.2 Identify the advantages of storing information online |
| | 4.3 Identify the risks if using online storage systems |

- | | | |
|--|-----|--|
| | 4.4 | Describe the threats to information security when working online |
| | 4.5 | Describe the threats to user safety when working online |
| 5 Know how to use ICT in the workplace | 5.1 | Identify workplace tasks that can be completed using ICT |
| | 5.2 | Demonstrate the safe and secure use of ICT |
| | 5.3 | Create and store their CV |
| | 5.4 | Demonstrate posting to blogs |
| | 5.3 | Use ICT to find and select information |

Assessment

There must be valid, authentic and sufficient for all the assessment criteria. However, one piece of evidence may be used to meet the requirements of more than one learning outcome or assessment criterion.



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