

## Component Specification

### Computational Methods and Problem Solving

NFQ Level 5

5N0554

#### 1. Component Details

<b>Title</b>	Computational Methods and Problem Solving
<b>Teideal as Gaeilge</b>	Réiteach Fadhbanna agus Modhanna Ríomhaireachtúla
<b>Award Class</b>	Minor
<b>Code</b>	5N0554
<b>Level</b>	5
<b>Credit Value</b>	15
<b>Purpose</b>	<p>Computational reasoning is an essential skill for the understanding, representation and solving of problems. This award enables learners to work with the techniques and processes utilised in computational and problem solving contexts. It equips them with the skills and tools and allow them to engage purposefully; making appropriate, informed decisions in order to solve problems, automate systems and transform data. Upon completion of this award, it is intended that learners will be able to:</p> <ul style="list-style-type: none"><li>- Recognise, identify and solve problems</li><li>- Demonstrate analytical reasoning and problem solving skills</li><li>- Decompose problems in terms of their significant components and the information needed to solve them</li><li>- Construct models and representations of both concrete and abstract systems</li><li>- Specify a model algorithmically for efficient solution by a computer</li><li>- Select and defend problem solutions</li></ul>

## Learning Outcomes

Learners will be able to:

- 1 Discrete Computational Structures and their application Demonstrate knowledge and understanding of numeric and structural data representations and usages to include: Data structures/representations such as arrays, lists, matrices trees, and their use e.g. ASCII Art, Computer Graphics, Gaussian Elimination (solving linear equations) Decision Matrices, Classical methods for sorting, searching and filtering data Functions and Recurrence Relations Demonstrate knowledge and understanding of the salient features of iterative and recursive algorithms and of where to apply each
- 2 Discrete Probability Demonstrate knowledge and understanding of elementary probability and information theory concepts to include:
  - Elementary probability distribution e.g. Gaussian)statistics (Sample Mean and Sample variance) and their applications
  - Calculate probabilities of events and expectations of random variables for elementary problems such as games of chance
  - How to Differentiate between dependent and independent events
  - Real world applications of conditional probabilities to problem solving
  - The use of random numbers in computing
  - Methods for generating pseudorandom numbers
  - The significance of randomness to modern computing systems e.g. PKI (Public Key Infrastructure)
- 3 Computational Modelling and Simulation Demonstrate knowledge and understanding of basic computer simulation methods to include: Computational methods Numerical methods e.g. Monte Carlo methods
- 4 Linear Algebra and Applications Apply knowledge and understanding of numeric and structural representations and usages to address computational approaches to real world problems e.g. practically employ use cases, of arrays/matrices e.g. in graphics, games scenarios, in Google PageRank algorithm, sequence alignment or nearest neighbour problems

- 5 Algorithms and Complexity Apply knowledge and understanding of algorithms to address computational approaches to real world problems e.g. assess the appropriateness of an algorithm or computational approach, for example in terms of speed, efficiency, best/expected/worst case behaviours.
- 6 Applications of Discrete Probability Apply knowledge and understanding of elementary probability and information theory to address computational approaches to real world problems e.g.: Conduct average case analysis of algorithms, perform failure prediction, perform software branch prediction, analyse network packet loss.
- 7 Computational Modelling and Simulation Differentiate between the principles of modelling and simulation and explain their use of abstraction that allows a machine to address a real world problem e.g. modelling the temperature in server room, or robot control or software for an autonomous vehicle.
- 8 Identify approaches to problem definition, solution design, testing and evaluation.
- 9 Outline the strengths and weaknesses of and primary areas of application for a range of contemporary problem definition and analysis techniques e.g. brute force, divide and conquer and heuristic strategies
- 10 Distinguish between pragmatic solving of a problem (using logic to treat the symptoms) and semantics (interpretation of the problem to establish the root cause).
- 11 Engage in an iterative process involving model creation and validation of the correspondence between the model and the real world situations being modelled e.g create a simple, formal mathematical model of a real world situation and use that model in a simulation e.g. modelling of the temperature in server room, or robot control, or software for an autonomous vehicle, or modelling traffic flow at an intersection.
- 12 Demonstrate awareness of the role of personal attributes such as initiative, methodical approach, logical reasoning, persistence and lateral thinking, in prevention and resolution of problems.
- 13 Reflect on the impact of employing numerical and logical thinking principles and concepts in the real world, including accuracy, precision and decisions

that may be made based on computer simulations and models.

## Assessment

### General Information

Details of FET assessment requirements are set out in [Assessment Guidelines for Providers](#).

All FET assessment is criterion referenced. Successful achievement of the award is based on learners attaining the required standards of knowledge, skill or competence.

The techniques set out below are considered the optimum approach to assessment for this component. In exceptional circumstances providers may identify alternative assessment techniques through the provider's application for programme validation which are **reliable** and **valid** but which are more appropriate to their context.

Assessment of a number of components may be integrated across programmes for delivery, provided that the learning outcomes of each minor award are assessed.

Group or team work may form part of the assessment, provided each learner's achievement is separately assessed.

All providers are required to submit an assessment plan as part of their application for programme validation. Assessment Plans will include information relating to scheduling and integration of assessment. See current FET validation guidelines at [www.qqi.ie](http://www.qqi.ie).

### Assessment Techniques

In order to demonstrate that they have reached the standards of knowledge, skill and competence identified in all the learning outcomes, learners are required to complete the assessment(s) below.

The assessor is responsible for devising assessment instruments (e.g. project and assignment briefs, examination papers), assessment criteria and mark sheets, consistent with the techniques identified below and FETAC's assessment requirements.

Programme validation will require providers to map each learning outcome to its associated assessment technique. See current FET validation guidelines at [www.qqi.ie](http://www.qqi.ie).

All learning outcomes **must** be assessed and achieved

Skills Demonstration                      70%

Examination - Theory 30%

## Description

### Skills Demonstration

*A skills demonstration is used to assess a wide range of practical based learning outcomes including practical skills and knowledge. A skills demonstration will require the learner to complete a task or series of tasks that demonstrate a range of skills.*

### Examination - Theory

*An examination provides a means of assessing a learner's ability to recall and apply knowledge, skills and understanding within a set period of time and under clearly specified conditions.*

*A theory-based examination assesses the ability to recall, apply and understand specific theory and knowledge.*

## Recognition of Prior Learning (RPL)

Learners may be assessed on the basis of their prior knowledge and experience. Providers must be specifically quality assured to assess learners by this means. To do so they must complete B10, see Provider's Quality Assurance Guidelines and be included on the Register of RPL approved providers. See RPL Guidelines at [www.fetac.ie](http://www.fetac.ie) for further information and registration details.

## Grading

Pass	50% - 64%
Merit	65% - 79%
Distinction	80% - 100%

## Specific Validation Requirements

There are no specific validation requirements

## Supporting Documentation

None

## Access

To access programmes leading to this award the learner should have reached the standards of knowledge, skill and competence associated with the preceding level of the National Framework of Qualifications. This may have been achieved through a formal qualification or through relevant life and work experience.

## Transfer

Successful completion of this component award enables the learner to transfer to programmes leading to other certificates where this component is a mandatory or an elective requirement.

## 2. FET Award Standards

QQI award standards are determined within the National Framework of Qualifications (NFQ), <http://www.nfq-qqi.com>. QQI determines standards for the education and training awards that it makes itself and that are made by providers to whom it has delegated authority to make an award. Providers offering programmes leading to QQI awards **must** have their programme(s) validated in accordance with current validation policy (see [www.qqi.ie](http://www.qqi.ie)).

Award standards are designed to be consistent with the NFQ's award classes i.e. major, special purpose, supplemental and minor awards. They are expressed in terms of **learning outcomes** i.e. concise statements of what the learner is expected to know or be able to do in order to achieve a particular award. Learning outcomes for FET awards are contained within the associated specifications:

AWARD CLASS	STANDARDS	AWARDS
Major Award	Certificate Specification	Certificate (Levels 1 to 5) Advanced Certificate (Level 6)
Supplemental Award	Supplemental Specification	Supplemental Certificate (Level 3 to 6)
Special Purpose	Specific Purpose Specification	Specific Purpose Certificate (Levels 3 to 6)
Minor Award	Component Specification	Component Certificate (Levels 1 to 6)

Award standards are thresholds, they describe standards of knowledge, skill or competence to be acquired, and where appropriate, demonstrated, by a learner before an award may be made.

Award standards will be reviewed from time to time as necessary. Minor changes may be made by the QQI executive outside the review cycle where necessary. Changes to standards are published on QQI's website. Providers with validated programmes and providers with delegated authority to make awards are responsible for monitoring relevant standards and making necessary responses to changes.

## 3. FET Credit

Every FET certificate and component specification includes an FET credit value (Table 1). FET credit is quantified in multiples of 5 FET credits (up to 50 hours of learner effort). Learner effort is based on the time taken by typical learners at the level of the award to achieve the learning outcomes for the award. It includes all learning time involved including: guided learning hours, self-directed learning and assessment.

**Table 1: FET Credit Values**

NFQ Level	Major Awards Credit Values	Default Credit Values Minor Awards	Other Permitted Minor Award Credit Values	Special Purpose and Supplemental Award Credit Value Ranges
1	20	5	10	

2	30	5	10	
3	60	10	5,20	>5 and<60
4	90	10	5,15,20	>5 and<90
5	120	15	5,10,30	>5 and <120
6	120	15	5,10,30	>5 and <120

## Guide to Level

Learning outcomes at this level include a broad range of skills that require some theoretical understanding. The outcomes may relate to engaging in a specific activity, with the capacity to use the instruments and techniques relating to an occupation. They are associated with work being undertaken independently, subject to general direction.

Strand	Sub-strand	Nature of learning
Knowledge	Breadth	Broad range of knowledge
	Kind	Some theoretical concepts and abstract thinking, with significant depth in some areas.
Know How & Skill	Range	Demonstrate a broad range of specialised skills and tools
	Selectivity	Evaluate and use information to plan and develop investigative strategies and to determine solutions to varied unfamiliar problems
Competence	Context	Act in a range of varied and specific contexts, taking responsibility for the nature and quality of outputs; identify and apply skill and knowledge to a wide variety of contexts
	Role	Exercise some initiative and independence in carrying out defined activities; join and function within multiple, complex and heterogeneous groups
	Learning to Learn	Learn to take responsibility for own learning within a managed environment
	Insight	Assume full responsibility for consistency of self- understanding and behaviour

*Extract from 'Determinations for the Outline National Framework of Qualifications': NQAI*