QQI
Quality and Qualifications Ireland
Dearbhú Cáilíochta agus Cáilíochtaí Éireann

QQI Consultation on:

NFQ Level 5 Standard: Maths for Computing

Introduction

The expert group set up by QQI to develop award specifications suitable for use within the Common Awards System (CAS) in the area of Information Technology (IT) agreed at their meeting on 18 July 2014 to explore the development of a Maths for Computing minor award specification for inclusion in the Maths pool as part of the certification requirements for the level 5 major awards in Software Developing and Computer Systems and Networks.

The group agreed to propose the IT suite of awards for adoption by the QQI Policies and Standards Committee at its meeting in September 2014 and that the development of the Maths for Computing would be considered outside the expert group.

QQI established an *ad hoc* group with expertise in Mathematics to explore the scope for a Maths for Computing minor to be used with the new IT awards. The current working draft originated with Michael Murphy, a member of the IT expert group, who consulted with colleagues in the sector on this development. The Group comprised:

- Michael Murphy, Limerick CFE
- Rory O'Sullivan, Principal, Killester College
- Anne Higgins, Director, Airglooney Education Centre, GRETB
- Joan Shalvey, Cork College of Commerce

The need for a new 15 credit math minor was discussed and it was considered there is a good case for its establishment--this can be tested further in due course during the public consultation process on the proposal

The Group developed the following award specification and recommended it to QQI.

QQI would like to consult with stakeholders on the proposed new award standard.

How to respond to this consultation document

QQI invites interested persons or organisations to make written observations on the drafts.

Prompts for feedback:

1. Clarity: Overall does the document make the expected knowledge, skill and competence sufficiently clear?
2. Alignment: Do you think that the expected learning outcomes align well, in terms of knowledge, skill and competence, with the NFQ's Level 5 award-type descriptor?
3. Amendment: Would you like to suggest amendments?
4. Comparability: How does the standard compare with the expectations of other relevant qualifications with which you are familiar?
5. Is there anything else that should be considered?
6. Is the credit value proportionate to the learning outcomes considering the credit value assigned to the Maths for STEM award (Code 5S17694)?

Submissions should be made by email to consultation@qqi.ie not later than **24 March 2015**

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CERTIFICATE DETAILS

Title: Maths for Computing

Award Class: Minor

Level 5

Credit Value: 15 FET Credits

Certificate Details

Title: Maths for Computing
Award Class: Minor Award
Level: 5
Credit Value: 15 FET Credits

Purpose: The purpose of this award is to certify relevant knowledge, skill and competence to apply a broad range of mathematical skills and tools to a wide variety of contexts especially in software development and/or working with computer systems and networks.

Learners should be able to:

Expected Learning Outcomes

The Learning Outcomes are grouped into the following units

1 Basic arithmetic and algebra
2 Set Theory and Boolean Logic
3 Functions and Calculus
4 Geometry & Trigonometry
5 Probability and Statistics
6 Algorithms and Computations

1. Basic arithmetic and algebra

1.1. Master the operations of addition, multiplication, subtraction and division in the N, Z, Q, R, domains including the rules of indices and logarithms.
1.2. Solve practical problems by choosing the correct formulae to calculate the area and perimeter of a square, rectangle, triangle, and circle.
1.3. Solve practical problems by choosing the correct formulae, to calculate the volume/capacity and surface area of a cube, cylinder, cone, and sphere.
1.4. Demonstrate a fundamental understanding of binary numbers. Perform binary addition. Convert from binary to base 10 and base 10 to binary.
1.5. Distinguish between an expression and an equation.
1.6. Evaluate, expand and simplify algebraic expressions.
1.7. Transpose formulae and perform arithmetic operations on polynomials and rational algebraic expressions.
1.8. Multiply linear expressions to produce quadratics and cubics.
1.9. Reduce quadratic expressions to products of linear expressions through the use of inspection to determine the factors. Use this to solve quadratic equations.
1.10. Solve quadratic equations with real and complex roots by factorisation or formula.
1.11. Solve linear inequalities.
1.12. Find a solution, if it exists, for simultaneous linear equations with 2 and 3 unknowns and interpret the results.

2. Set Theory and Boolean Logic

2.1. Demonstrate a fundamental understanding of the language of set theory including: universal set, subsets, sets N, Z, Q, R, C and ø, finite and infinite sets, and cardinal number of a set.
2.2. Use the basic operations on sets including union, intersection, complement, symmetric difference, Cartesian product, and power set.
2.3. Use Venn diagrams of two and three sets to represent relationships between sets.
2.4. Define and apply the truth tables for (N)AND, NOT, (N)OR and XOR.
2.5. Use truth tables to establish logical equivalences, for example De Morgan's Laws.

3. Functions and Calculus

3.1. Recognise that a function assigns a single output to every input, understand the concept of an inverse function and be able to compute it in simple algebraic cases.
3.2. Graph linear, quadratic and cubic functions and use these graphs to solve equations f(x)=0, f(x)=k, and f(x)=g(x).
3.3. Define and graph simple and trigonometric functions.
3.4. Complete the square for a quadratic function and hence determine its roots and vertex.
3.5. Investigate the concept of the limit of a function and compute the limits of linear, quadratic and quotient functions, and understand the idea of a continuous function.
3.6. Understand how a derivative arises as a limit from looking for tangent lines or rates of change.
3.7. Use the sum, product and quotient formulas for differentiation and the chain rule to differentiate simple functions that are a composition of several functions.

4. Geometry and Trigonometry

<u>Co-ordinate geometry</u>

4.1. Work with linear equations of the form ax + by + c = 0.
4.2. Solve problems involving slope of a line to include investigating parallel and perpendicular lines.
4.3. Solve problems involving midpoint and length of a line segment.
4.4. Apply the Pythagorean Theorem.

<u>Trigonometry</u>

4.5. Demonstrate understanding of the concepts of degree and radian measure.
4.6. Define sin (θ), cos (θ), tan (θ), using right angled triangles and using the unit circle having regard to amplitude, phase and period.
4.7. Work with trigonometric ratios in root form.
4.8. Solve problems involving the area of a triangle using the formula area = ½ab sin Θ.
4.9. Solve practical problems using trigonometric formulae and terminology, including the sine, cosine and tangent ratios for right angled triangles.
4.10. Solve practical problems using the Sine Rule and Cosine Rule.

5. Probability and Statistics

<u>Counting</u>

5.1. List outcomes of an experiment.
5.2. Apply the fundamental principle of counting.
5.3. Count the arrangements of n distinct objects (n!).
5.4. Count the number of ways of arranging r objects from n distinct objects.
5.5. Count the number of ways of selecting r objects from n distinct objects.

<u>Probability</u>

5.6. Recognise that probability is a measure on a scale of 0-1 of how likely an event is to occur.
5.7. Understand the concepts and be able to calculate probabilities by counting equally likely outcomes.
5.8. Understand the concepts and be able to calculate compound probabilities of independent events and of mutually exclusive events describing data graphically and numerically.

Statistics

5.9. Understand the different types of data: categorical: nominal or ordinal numerical: discrete or continuous.
5.10. Demonstrate an understanding of the relative effectiveness of different displays in representing the findings of a statistical investigation (pie charts, histograms, stem and leaf plots).
5.11. Use frequency tables and histograms to display data.
5.12. Understand and be able to compute:-
- mean, median, mode to measure central tendency
- range and standard deviation to measure variability

5.13. Discuss the limitations or merits of mean, median and mode for measuring central tendency with symmetric data and with skewed data.

6. Algorithms and Computations

6.1. Explain the concept of an algorithm.
6.2. Relate the concept of an algorithm to that of a mathematical function acting on a domain of possible inputs.
6.3. Manipulate lists and arrays including addition and multiplication.
6.4. Use the mathematical notations involved in using lists and arrays including the index, sigma and pi notation.
6.5. Apply lists and arrays to simple problems such as shopping lists and prices.
6.6. Describe the divide and conquer approach to solving problems.
6.7. Use algorithms/functions for carrying out simple operations on one dimensional arrays by iterating over an index.
6.8. Use algorithms for simple computational problems using recursion including linear search and binary search; and sort techniques including bubble sort, insertion sort, selection sort and shell sort.

Assessment

- Assignment (2 x 30%) 60% (Specific validation condition: proctored assessment must be used for assessment of assignments)
- Theory Based Exam 40%