Cork Education and Training Board

Programme Module for

Maths for STEM

leading to

Level 5 QQI

Maths for STEM 5N0556

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Introduction
This programme module may be delivered as a standalone module leading to certification in a QQI minor award. It may also be delivered as part of an overall validated programme leading to a Level 5 QQI Certificate.

This award specification is designed to facilitate access to higher education STEM (Science, Technology, Engineering and Mathematics) programmes subject to the agreement of the HE institutions concerned. The award will be available to those learners who have demonstrated knowledge, skill and competence in mathematics suitable for successful participation in HE STEM programmes (as prescribed in this award specification).

This award may be used for access to higher education and/or in place of the 15 credit L5 Math minor (5N1833) where it appears in certificate requirements for a major award. If desired the additional 15 credits from the Math for STEM award may be applied to the pool of residual credit or in place of any mathematically oriented minor in the elective pool of the same major award.

The teacher/tutor should familiarise themselves with the information contained in Cork Education and Training Board's programme descriptor for the relevant validated programme prior to delivering this programme module.

The programme module is structured as follows:

1. Title of Programme Module
2. QQI Component Title and Code
3. Duration in hours
4. Credit Value of QQI Component
5. Status
6. Special Requirements
7. Aim of the Programme Module
8. Objectives of the Programme Module
9. Learning Outcomes
10. Indicative Content
11. Assessment a. Assessment Technique(s) b. Mapping of Learning Outcomes to Assessment Technique(s) c. Guidelines for Assessment Activities
12. Grading
13. Learner Marking Sheet(s), including Assessment Criteria

Integrated Delivery and Assessment
The teacher/tutor is encouraged to integrate the delivery of content where an overlap between content of this programme module and one or more other programme modules is identified. This programme module will facilitate the learner to develop the academic and vocational language, literacy and numeracy skills relevant to the themes and content of the module.

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Likewise the teacher/tutor is encouraged to integrate assessment where there is an opportunity to facilitate a learner to produce one piece of assessment evidence which demonstrates the learning outcomes from more than one programme module. The integration of the delivery and assessment of level 5 Communications and level 5 Mathematics modules with that of other level 5 modules is specifically encouraged, as appropriate.

Indicative Content

The indicative content in Section 10 does not cover all teaching possibilities. The teacher/tutor is encouraged to be creative in devising and implementing other approaches, as appropriate. The use of examples is there to provide suggestions. The teacher/tutor is free to use other examples, as appropriate. The indicative content ensures all learning outcomes are addressed but it may not follow the same sequence as that in which the learning outcomes are listed in Section 9. It is the teacher's/tutor's responsibility to ensure that all learning outcomes are included in the delivery of this programme module.

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1. Title of Programme Module
Maths for STEM

2. Component Name and Code
Maths for STEM 5N0556

3. Duration in Hours
300 Hours (typical learner effort, to include both directed and self directed learning)

4. Credit Value
30 Credits

5. Status
This programme module may be compulsory or optional within the context of the validated programme. Please refer to the relevant programme descriptor, Section 9 Programme Structure

6. Special Requirements
None

7. Aim of the Programme Module
The programme module aims to equip the learner with the knowledge, skill and competence in a broad range of mathematical skills, in order to facilitate entry to and successful participation in Higher Education STEM (Science, Technology, Engineering & Mathematics) programmes.

8. Objectives of the Programme Module

- To broaden and deepen learners' mathematical knowledge and support their use of this knowledge to enrich their lives.
- To enable the learner to acquire mathematical skill in problem solving and mathematical investigations in the following areas: mathematical proficiency, number, set theory & logic, algebra, functions & calculus, geometry & trigonometry, statistics and probability.
- To assist the learner to develop the academic and vocational language, literacy and numeracy skills related to Maths for STEM 5N0556 through the medium of the indicative content
- To enable the learner to take responsibility for his/her own learning.
- To facilitate the learner to develop competence in problem solving, mathematical, computation, mathematical thinking and conceptual development

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9. Learning Outcomes of Level 5 Maths for STEM 5N0556

1 Mathematical Proficiency

The purpose of the outcomes presented in this unit (Mathematical Proficiency) is to recognise learners who are mathematically proficient.

The expected learning outcomes in units 2-7 set out the scope of the expected mathematical proficiency.

These express outcomes in units that cover parts of mathematics, for example number, but this must not be interpreted as an expectation that learners will learn the parts in a disconnected way without reference to the other parts.
Learners must not only be able to demonstrate procedural fluency but the broader mathematical proficiency required to solve unfamiliar problems within the scope of this specification. This proficiency includes the ability to abstract mathematical models of certain kinds of physical entities, perform calculations using them and make inferences about the physical entities on the basis of these calculations.

In the language of 'Project Maths1' students need to be 'mathematically proficient'. Mathematical proficiency is characterised by 5 components:

- Conceptual understanding: Comprehension of mathematical concepts, operations and relations
- Strategic Competence: The ability to formulate, represent and solve mathematical problems
- Procedural fluency: Skill in carrying out procedures flexibly, accurately, efficiently and appropriately
- Adaptive reasoning: Capacity for logical thought, reflection, explanation and justification
- Productive disposition: Habitual inclination to see mathematics as sensible, useful, worthwhile, coupled with a belief in diligence and one's own efficacy.

2 Number

Number is a key concept in science, technology, engineering and mathematics (STEM). A strong knowledge of, and skills in, basic mathematical calculation, and competence to apply these with mastery, is essential for successful participation in STEM programmes.
The purpose of the outcomes presented in this unit (Number) is to recognise learners who have an insight into the use and application of numbers and numerical operations and have mastered the skills for reliable and accurate calculation. Achievement (with mastery) of the learning outcomes in this unit is essential for award of the L5 Maths for STEM qualification.

2.1 Master the operations of addition, multiplication, subtraction and division in the

N, Z, Q, R, domains. Represent these numbers on a number line. Understand

absolute value as a measure of distance on the number line.

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2.2 Be able to make basic calculations without any errors, with and without the use of a calculator. Verify the accuracy of these calculations using estimates and approximations.

2.3 Convert fractions to percentages, and numbers to scientific notation and calculate percentage error.

2.4 Solve practical problems by choosing the correct formula(e) to calculate the area and perimeter of a square, rectangle, triangle, and circle, giving the answer in the correct form and using the correct units.

2.5 Solve practical problems by choosing the correct formula(e), to calculate the volume/capacity and surface area of a cube, cylinder, cone, and sphere, giving the answer in the correct form and using the correct terminology

2.6 Use the trapezoidal rule to approximate area.

2.7 Solve problems using the rules for indices and the rules for logarithms.

2.8 Demonstrate a fundamental understanding of binary numbers. Represent a number as a binary number. Perform binary addition. Convert from binary to base 10 and base 10 to binary.

2.9 Understand the concept of a complex number and illustrate their representation on an Argand diagram, be able to add, subtract and multiply complex numbers and calculate and interpret the modulus of a complex number.

3 Set Theory and Logic

The concept of 'set' is important in STEM disciplines.
The purpose of the outcomes in this unit is to recognise learners who can conceptualise sets and have the tools and skills required for exploring and expressing the relationships between sets. These include the Boolean logic skills required to analyse statements (propositions) and use equivalence of compound statements and test their validity in the context of practical applications.

3.1Use the language of set theory appropriately including: universal set, subsets,

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sets N, Z, Q, R, C and ø, finite and infinite sets, and cardinal number of a set.

3.2 Explain the basic operations on sets including union, intersection, complement, symmetric difference, Cartesian product, and power set.

3.3 Use Venn diagrams of two and three sets to represent relationships between sets.

3.4 Define the Boolean operations AND, NOT, OR and XOR.

3.5 Define propositions/statements .

3.6 Define the truth tables for the compound statements AND, NOT, OR and XOR.

3.7 Use truth tables to establish logical equivalences for example De Morgan's Laws.

3.8 Explain the relationship between logical equivalences and set identities.

4 Algebra

Strong knowledge of, and skills in basic algebra and the ability to apply these skills to a range of problems is essential for the solution of many problems in STEM disciplines.
The purpose of the outcomes in this unit is to recognise learners who have an insight in to methods for the manipulation of algebraic expressions and are able to demonstrate ability, with mastery, to reliably manipulate algebraic expressions. Achievement (mastery) of the learning outcomes in this unit is essential for award of the L5 Maths for STEM qualification.

4.1 Distinguish between an expression and an equation.

4.2 Evaluate, expand and simplify algebraic expressions.

4.3 Transpose formulae and perform arithmetic operations on polynomials and rational algebraic expressions.

4.4 Multiply linear expressions to produce quadratics and cubics.

Reduce quadratic expressions to products of linear expressions through the use of inspection to determine the factors. Use this to solve quadratic equations.

4.6 Solve quadratic equations with real and complex roots by factorisation or formula. (see Functions 5.5) Solve cubic equations with at least one integer root.

4.7 Solve linear inequalities.

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4.8 Find a solution, if it exists, for simultaneous linear equations with 2 and 3 unknowns and interpret the results.

5 Functions and Calculus

The mathematical notion of a function is important in STEM disciplines. This notion is not confined to real valued function of a real variable.
The purpose of the outcomes on this unit is to recognise learners who, in the special case of a real valued function of a real variable, have been introduced to the differential and integral calculus and are able to use these to investigate such functions and to show how real life problems of rates of change, areas and averages can be solved. Learners should not only be able to perform routine calculations, although mastering of these is an absolute requirement, but should also understand the theory, the power, and the limitations of the methods concerned.

5.1 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.

5.2 Use mathematical modelling to investigate the relationship between two variables

5.3 Graph linear, quadratic, and cubic functions, and use these graphs to solve equations f(x) = 0, f(x) = k and f(x) = g(x).

5.4 Define and graph simple exponential, logarithmic, and trigonometric functions.

5.5 Understand growth/decay characteristics of different types of functions

5.5 Complete the square for a quadratic function and hence determine its roots and turning point. (see Algebra 4.5)

5.6 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.

5.7 Understand how a derivative arises as a limit from looking for tangent lines or rates of change.

5.8 Differentiate the following types of function: polynomial, trigonometric, rational power, exponential and logarithmic.

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5.9 Use the sum, product and quotient formulas for differentiation and the chain rule to differentiate functions that are a composition of several functions.

5.10 Use derivatives to calculate tangent lines, rates of changes, maxima and minima, and whether functions are increasing or decreasing.

5.11 Understand that the definite integral of a positive function defines the area under a curve and that the Fundamental Theorem of Calculus reduces integration to finding anti-derivatives/indefinite integrals.

5.12 Be able to find the anti-derivative of polynomials, exponential, and trigonometric functions and linear combinations of these.

5.13 Be able to find the area under such positive curves.

5.14 Understand that a definite integral also gives the average of a function over an interval multiplied by the length of the interval and hence find average values.

6 Geometry and Trigonometry

Logical thought and deductive reasoning are key to STEM disciplines. Synthetic Geometry provides a mechanism for exploring logical thought and deductive reasoning. Through the proving of theorems learners will have the concept of a clear conclusion and the value of a clear proof.

The purpose of trigonometry and co-ordinate geometry is to provide learners with basic tools to solve problems in, and explore truths about, the physical world.

These theorems specified in the section on Synthetic Geometry should be known (proof not required for all) and the learner should be capable of applying them to solve practical problems across all areas of mathematics.

Synthetic Geometry

Know the statement of, and be able to solve problems using, the following theorems:

6.1 Theorem 1: Vertically opposite angles are equal in measure.

6.2 Theorem 2: Isosceles triangle: In an isosceles triangle the angles opposite the equal sides are equal. (ii) Conversely, if the two angles are equal, then the triangle is isosceles.

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6.3 Theorem 3: Alternate angles: Suppose that A and D are on opposite sides of the line BC. If |∠ ABC| = |∠ BCD|, then AB || CD. In other words, if a transversal makes equal alternate angles on two lines, then the lines are parallel. Conversely, if AB || CD, then |∠ ABC| = |∠ BCD. In other words, if two lines are parallel, then any transversal will make equal alternate angles with them.

6.4 Theorem 4: The angles in any triangle add to 180 degrees.

6.5 Theorem 5: Corresponding Angles: Two lines are parallel if and only if for any transversal, corresponding angles are equal.

6.6 Theorem 6: Each exterior angle of a triangle is equal to the sum of the interior opposite angles.

6.7 Theorem 7: (i) In Δ ABC, suppose that |AC| > |AB|. Then |∠ ABC| > |∠ ACB|. In other words, the angle opposite the greater of two sides is greater than the angle opposite the lesser side. (ii) Conversely, if |∠ ABC| > |∠ ACB|, then |AC| > |AB|. In other words, the side opposite the greater of two angles is greater than the side opposite the lesser angle.

6.8 Theorem 8: Two sides of a triangle are together greater than the third.

6.9 Theorem 9: In a parallelogram, opposite sides are equal, and opposite angles are equal.

6.10 Theorem 10: The diagonals of a parallelogram bisect each other.

6.11 Theorem 11: If three parallel lines cut off equal segments on some transversal line, then they will cut off equal segments on any other transversal.

6.12 Theorem 12: Let Δ ABC be a triangle. If a line l is parallel to BC and cuts [AB] in the ratio s : t, then it also cuts [AC] in the same ratio. Know the proposition that if two triangles Δ ABC and Δ A'B'C' have |∠ A| = |∠ A'|, and |A'B'|/|AB| = |A'C'|/|AC|, then they are similar.

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6.13 Theorem 13: If two triangles Δ ABC and Δ A'B'C' are similar, then their sides are proportional in order.

6.14 Theorem 14: Pythagoras: In a right angle triangle the square of the hypotenuse is the sum of the squares of the other two sides.

6.15 Theorem 15: Converse to Pythagoras: If the square of one side of a triangle is the sum of the squares of the other two, then the angle opposite the first side is a right angle.

6.16 Theorem 16: For a triangle, base times height does not depend on the choice of base.

6.17 Theorem 17: A diagonal of a parallelogram bisects the area.

6.18 Theorem 18: The area of a parallelogram is the base by the height.

6.19 Theorem 19: The angle at the centre of a circle standing on a given arc is twice the angle at any point of the circle standing on the same arc.

6.20 Theorem 20: (i) Each tangent is perpendicular to the radius that goes to the point of contact. (ii) If P lies on the circle s, and a line l through P is perpendicular to the radius to P, then l is tangent to s.

6.21 Theorem 21: The perpendicular from the centre of a circle to a chord bisects the chord.

6.22 Prove theorems 1, 3, 4, 12, 14.

Co-ordinate geometry

6.23 Work with linear equations ax + by + c =0.

6.24 Solve problems involving slope of a line to include investigating parallel and perpendicular lines.

6.25 Solve problems involving midpoint and length of a line segment.

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6.26 Recognise that (x-h)^2 + (y-k)^2 = r^2 represents the relationship between the x and y co-ordinates of points on a circle with centre (h, k) and radius r.

Trigonometry

6.27 Understand the concepts of degree and radian measure.

6.28 Define sin θ, cos θ, tan θ, using right angled triangles and using the unit circle.

6.29 Work with trigonometric ratios in root form.

6.30 Solve problems involving the area of a triangle using the formula area = ½ab sin Θ

6.31 Solve practical problems using trigonometric formulae and terminology, including the sine, cosine and tangent ratios for right angled triangles.

6.32 Solve practical problems using the Sine Rule and Cosine Rule.

7 Probability and Statistics

Statistics is the science of data and statistical methods are underpinned by probability which is an important part of Maths. With the vast increase in the amount of data produced in all areas of STEM it is important that anyone pursuing further study or aiming to work in this field should be capable of analysing data. The purpose of the outcomes in this unit is to recognise learners who understand the basic concepts of probability and fundamental principles important in all data collection in STEM and who can apply basic methods for describing and evaluating data.

Counting

7.1 List outcomes of an experiment.

7.2 Apply the fundamental principle of counting (that if one event has m possible outcomes and a second independent event has n possible outcomes, then there are m x n total possible outcomes for the two events together).

7.3 Count the arrangements of n distinct objects (n!).

Count the number of ways of arranging r objects from n distinct objects.

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7.5 Count the number of ways of selecting r objects from n distinct objects.

Probability

7.6 Recognise that probability is a measure on a scale of 0-1 of how likely an event is to occur.

7.7 Engage in discussions about the purpose of probability.

7.8 Associate the probability of an event with its long run relative frequency .

7.9 Understand the concepts and be able to calculate probabilities by counting equally likely outcomes

7.10 Understand the concepts and be able to calculate compound probabilities of independent events and of mutually exclusive events

Statistical reasoning and data collection

7.11 Engage in discussions about the purpose of statistics and recognise misconceptions and misuses of statistics.

7.12 Discuss populations and samples.

7.13 Recognise the importance of representativeness so as to avoid biased samples and decide to what extent conclusions can be generalised from a sample to a population.

7.14 Understand how to select a sample using Simple Random Sampling.

7.15 Understand that randomness and representativeness are not the same.

7.16 Recognise that not every sample is the same and that different samples may lead to different estimates about a given population – this concept is known as sampling variability.

7.17 Discuss different types of studies: sample surveys, observational studies and

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designed experiments.

7.18 Design a plan and collect data on the basis of above knowledge.

Describing data graphically and numerically

7.19 Understand the different types of data: categorical: nominal or ordinal

numerical: discrete or continuous.

7.20 Discuss the effectiveness of different displays in representing the findings of a statistical investigation (pie charts, histograms, stem and leaf plots).

7.21 Use histograms (equal intervals) to display data.

7.22 Understand and be able to compute:-

- mean, median, mode to measure central tendency;
- range and standard deviation (use a calculator to calculate standard deviation) to measure variability.

7.23 By reference to histograms, describe a distribution of data in terms of symmetry and skewness.

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

7.25 Understand what bivariate data is and determine the relationship between variables using scatterplots.

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10. Indicative Content

This section provides suggestions for programme content but is not intended to be prescriptive. The programme module can be delivered through classroom based learning, computer based learning, group discussions, one -to -one tutorials, field trips, case studies, role play and other suitable activities, as appropriate.

1 Mathematical Proficiency

The purpose of the outcomes presented in this unit (Mathematical Proficiency) is to recognise learners who are mathematically proficient.

The expected learning outcomes in units 2-7 set out the scope of the expected mathematical proficiency.

These express outcomes in units that cover parts of mathematics, for example number, but this must not be interpreted as an expectation that learners will learn the parts in a disconnected way without reference to the other parts. Tutors are encourages to combine topics from the different sections of this course where possible so as to encourage students to see mathematics as a unified whole, rather than as a series of disjointed topics.
Learners must not only be able to demonstrate procedural fluency but the broader mathematical proficiency required to solve unfamiliar problems within the scope of this specification. This proficiency includes the ability to abstract mathematical models of certain kinds of physical entities, perform calculations using them and make inferences about the physical entities on the basis of these calculations.

In the language of 'Project Maths1' students need to 'mathematically proficient'. Mathematical proficiency is characterised by 5 components:

- Conceptual understanding: Comprehension of mathematical concepts, operations and relations
- Strategic Competence: The ability to formulate, represent and solve mathematical problems
- Procedural fluency: Skill in carrying out procedures flexibly, accurately, efficiently and appropriately
- Adaptive reasoning: Capacity for logical thought, reflection, explanation and justification
- Productive disposition: Habitual inclination to see mathematics as sensible, useful, worthwhile, coupled with a belief in diligence and one's own efficacy.

The learner will be facilitated to become proficient in all of the above.

2 Number

Number is a key concept in science, technology, engineering and mathematics (STEM). A strong knowledge of, and skills in, basic mathematical calculation, and competence to apply these with mastery, is essential for successful participation in STEM programmes.
The purpose of the outcomes presented in this unit (Number) is to recognise learners who have an insight into the use and application of numbers and numerical operations and have mastered the skills for reliable and accurate calculation.

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Facilitate the learner to:

2.1 Master the operations of addition, multiplication, subtraction and division in the N, Z, Q, R, domains. The learner will be able to represent these numbers on a number line. The learner will be able to understand absolute value as a measure of distance on the number line.

2.2 Be able to make basic calculations without any errors, with and without the use of a calculator. The learner will be able to verify the accuracy of these calculations using estimates and approximations.

2.3 Convert fractions to percentages, and numbers to scientific notation and calculate percentage error.

2.4 Solve practical problems by choosing the correct formula(e) to calculate the area and perimeter of a square, rectangle, triangle, and circle, giving the answer in the correct form and using the correct units.

2.5 Solve practical problems by choosing the correct formula(e), to calculate the volume/capacity and surface area of a cube, cylinder, cone, and sphere, giving the answer in the correct form and using the correct terminology

2.6 Use the trapezoidal rule to approximate area.

2.7 Solve problems using the rules for indices and the rules for logarithms.

2.8 Demonstrate a fundamental understanding of binary numbers. The learner will be able to represent a number as a binary number. The learner will be able to perform binary addition. The learner will be able to convert from binary to base 10 and base 10 to binary. The learner will be able to name contexts where binary numbers are used.

2.9 Understand the concept of a complex number and illustrate their representation on an Argand diagram. The learner will be able to add, subtract and multiply

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complex numbers and calculate and interpret the modulus of a complex number.

3 Set Theory and Logic

The concept of 'set' is important in STEM disciplines.
The purpose of the outcomes in this unit is to recognise learners who can conceptualise sets and have the tools and skills required for exploring and expressing the relationships between sets. These include the Boolean logic skills required to analyse statements (propositions) and use equivalence of compound statements and test their validity in the context of practical applications.

Facilitate the learner to:

3.1Use the language of set theory appropriately including: universal set, subsets, sets N, Z, Q, R, C and ø, finite and infinite sets, and cardinal number of a set.

3.2 The learner will be able to explain the basic operations on sets including union, intersection, complement, symmetric difference, Cartesian product, and power set.

3.3 The learner will be able to use Venn diagrams of two and three sets to represent relationships between sets.

3.4 The learner will be able to define the Boolean operations AND, NOT, OR and XOR.

3.5 The learner will be able to define propositions/statements .

3.6 The learner will be able to define the truth tables for the compound statements AND, NOT, OR and XOR.

3.7 The learner will be able to use truth tables to establish logical equivalences for example De Morgan's Laws.

3.8 The learner will be able to explain the relationship between logical equivalences and set identities.

4 Algebra

Strong knowledge of, and skills in basic algebra and the ability to apply these skills to a range of problems is essential for the solution of many problems in STEM disciplines.
The purpose of the outcomes in this unit is to recognise learners who have an insight in to methods for the manipulation of algebraic expressions and are able to

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demonstrate ability, with mastery, to reliably manipulate algebraic expressions.

Facilitate the learner to:

4.1 Distinguish between an expression and an equation.

4.2 Evaluate, expand and simplify algebraic expressions.

4.3 Transpose formulae and perform arithmetic operations on polynomials and rational algebraic expressions.

4.4 Multiply linear expressions to produce quadratics and cubics. The learner will be able to reduce quadratic expressions to products of linear expressions through the use of inspection to determine the factors. The learner will be able to use this to solve quadratic equations.

4.6 The learner will be able to solve quadratic equations with real and complex roots by factorisation or formula. (see Functions 5.5) The learner will be able to solve cubic equations with at least one integer root.

4.7 The learner will be able to solve linear inequalities.

4.8 The learner will be able to find a solution, if it exists, for simultaneous linear equations with 2 and 3 unknowns and interpret the results.

5 Functions and Calculus

The mathematical notion of a function is important in STEM disciplines. This notion is not confined to real valued function of a real variable.
The purpose of the outcomes on this unit is to recognise learners who, in the special case of a real valued function of a real variable, have been introduced to the differential and integral calculus and are able to use these to investigate such functions and to show how real life problems of rates of change, areas and averages can be solved. Learners should not only be able to perform routine calculations, although mastering of these is an absolute requirement, but should also understand the theory, the power, and the limitations of the methods concerned.

Facilitate the learner to:

5.1 Recognise that a function assigns a single output to every input, understand the concept of an inverse function and the learner will be able to compute it in simple

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algebraic cases.

5.2 Use mathematical modelling to investigate the relationship between two variables

5.3 Graph linear, quadratic, and cubic functions, and use these graphs to solve equations $f(x) = 0$, $f(x) = k$ and $f(x) = g(x)$.

5.4 Define and graph simple exponential, logarithmic, and trigonometric functions.

5.5 Understand growth/decay characteristics of different types of functions

5.5 Complete the square for a quadratic function and hence determine its roots and turning point. (see Algebra 4.5)

5.6 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.

5.7 Understand how a derivative arises as a limit from looking for tangent lines or rates of change.

5.8 Differentiate the following types of function: polynomial, trigonometric, rational power, exponential and logarithmic.

5.9 The learner will be able to use the sum, product and quotient formulas for differentiation and the chain rule to differentiate functions that are a composition of several functions.

5.10 The learner will be able to use derivatives to calculate tangent lines, rates of changes, maxima and minima, and whether functions are increasing or decreasing.

5.11 The learner will be able to understand that the definite integral of a positive function defines the area under a curve and that the Fundamental Theorem of Calculus reduces integration to finding anti-derivatives/indefinite integrals.

5.12 The learner will be able to find the anti-derivative of polynomials, exponential,

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and trigonometric functions and linear combinations of these.

5.13 The learner will be able to find the area under such positive curves.

5.14 The learner will be able to understand that a definite integral also gives the average of a function over an interval multiplied by the length of the interval and hence be able to find average values.

6 Geometry and Trigonometry

Logical thought and deductive reasoning are key to STEM disciplines. Synthetic Geometry provides a mechanism for exploring logical thought and deductive reasoning. Through the proving of theorems learners will have the concept of a clear conclusion and the value of a clear proof.
The purpose of trigonometry and co-ordinate geometry is to provide learners with basic tools to solve problems in, and explore truths about, the physical world.
These theorems specified in the section on Synthetic Geometry should be known (proof not required for all) and the learner should be capable of applying them to solve practical problems across all areas of mathematics.

Synthetic Geometry

Facilitate the learner to know the statement of, and be able to solve problems using, the following theorems:

6.1 Theorem 1: Vertically opposite angles are equal in measure. 6.2 Theorem 2: Isosceles triangle: In an isosceles triangle the angles opposite the equal sides are equal. (ii) Conversely, if the two angles are equal, then the triangle is isosceles.

6.3 Theorem 3: Alternate angles: Suppose that A and D are on opposite sides of the line BC. If |∠ ABC| = |∠ BCD|, then AB || CD. In other words, if a transversal makes equal alternate angles on two lines, then the lines are parallel. Conversely, if AB || CD, then |∠ ABC| = |∠ BCD. In other words, if two lines are parallel, then any transversal will make equal alternate angles with them. 6.4 Theorem 4: The angles in any triangle add to 180 degrees.

6.5 Theorem 5: Corresponding Angles: Two lines are parallel if and only if for any transversal, corresponding angles are equal.

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6.6 Theorem 6: Each exterior angle of a triangle is equal to the sum of the interior opposite angles.

6.7 Theorem 7: (i) In Δ ABC, suppose that |AC| > |AB|. Then |∠ ABC| > |∠ ACB|. In other words, the angle opposite the greater of two sides is greater than the angle opposite the lesser side. (ii) Conversely, if |∠ ABC| > |∠ ACB|, then |AC| > |AB|. In other words, the side opposite the greater of two angles is greater than the side opposite the lesser angle.

6.8 Theorem 8: Two sides of a triangle are together greater than the third.

6.9 Theorem 9: In a parallelogram, opposite sides are equal, and opposite angles are equal.

6.10 Theorem 10: The diagonals of a parallelogram bisect each other.

6.11 Theorem 11: If three parallel lines cut off equal segments on some transversal line, then they will cut off equal segments on any other transversal.

6.12 Theorem 12: Let Δ ABC be a triangle. If a line l is parallel to BC and cuts [AB] in the ratio s : t, then it also cuts [AC] in the same ratio. Know the proposition that if two triangles Δ ABC and Δ A'B'C' have |∠ A| = |∠ A'|, and |A'B'|/|AB| = |A'C'|/|AC|, then they are similar

6.13 Theorem 13: If two triangles Δ ABC and Δ A'B'C' are similar, then their sides are proportional in order.

6.14 Theorem 14: Pythagoras: In a right angle triangle the square of the hypotenuse is the sum of the squares of the other two sides. 6.15 Theorem 15: Converse to Pythagoras: If the square of one side of a triangle is the sum of the squares of the other two, then the angle opposite the first side is a right angle.

6.16 Theorem 16: For a triangle, base times height does not depend on the choice of base.

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6.17 Theorem 17: A diagonal of a parallelogram bisects the area.

Theorem 18: The area of a parallelogram is the base by the height.

6.19 Theorem 19: The angle at the centre of a circle standing on a given arc is twice the angle at any point of the circle standing on the same arc.

6.20 Theorem 20: (i) Each tangent is perpendicular to the radius that goes to the point of contact. (ii) If P lies on the circle s, and a line l through P is perpendicular to the radius to P, then l is tangent to s.

6.21 Theorem 21: The perpendicular from the centre of a circle to a chord bisects the chord.

6.22 The learner will be able to prove Theorems 1, 3, 4, 12, 14.

Co-ordinate geometry

Facilitate the learner to:

6.23 Work with linear equations ax + by + c =0.

6.24 The learner will be able to solve problems involving slope of a line to include investigating parallel and perpendicular lines.

6.25 The learner will be able to solve problems involving midpoint and length of a line segment.

6.26 The learner will be able to recognise that (x-h)^2 + (y-k)^2 = r^2 represents the relationship between the x and y co-ordinates of points on a circle with centre (h, k) and radius r.

Trigonometry

Facilitate the learner to be able to:

6.27 Understand the concepts of degree and radian measure.

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6.28 Define sin θ, cos θ, tan θ, using right angled triangles and using the unit circle.

6.29 Work with trigonometric ratios in root form.

6.30 Solve problems involving the area of a triangle using the formula area = ½ab sin

Θ

6.31 Solve practical problems using trigonometric formulae and terminology,

including the sine, cosine and tangent ratios for right angled triangles.

6.32 Solve practical problems using the Sine Rule and Cosine Rule.

7 Probability and Statistics

Statistics is the science of data and statistical methods are underpinned by probability which is an important part of Maths. With the vast increase in the amount of data produced in all areas of STEM it is important that anyone pursuing further study or aiming to work in this field should be capable of analysing data. The purpose of the outcomes in thus unit is to recognise learners who understand the basic concepts of probability and fundamental principles important in all data collection in STEM and who can apply basic methods for describing and evaluating data.

Counting

Facilitate the learner to be able to:

7.1 List outcomes of an experiment.

7.2 Apply the fundamental principle of counting (that if one event has m possible

outcomes and a second independent event has n possible outcomes, then there are

m x n total possible outcomes for the two events together).

7.3 Count the arrangements of n distinct objects (n!).

The learner will be able to count the number of ways of arranging r objects from n

distinct objects.

7.5 Count the number of ways of selecting r objects from n distinct objects.

Probability

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Facilitate the learner to:

7.6 Recognise that probability is a measure on a scale of 0-1 of how likely an event is to occur.

7.7 Be able to engage in discussions about the purpose of probability.

7.8 Associate the probability of an event with its long run relative frequency .

7.9 Understand the concepts and be able to calculate probabilities by counting equally likely outcomes

7.10 Understand the concepts and be able to calculate compound probabilities of independent events and of mutually exclusive events

Statistical reasoning and data collection

Facilitate the learner to:

7.11 Engage in discussions about the purpose of statistics and recognise misconceptions and misuses of statistics.

7.12 be able to discuss populations and samples.

7.13 Recognise the importance of representativeness so as to avoid biased samples and decide to what extent conclusions can be generalised from a sample to a population.

7.14 Understand how to select a sample using Simple Random Sampling.

7.15 Understand that randomness and representativeness are not the same.

7.16 Recognise that not every sample is the same and that different samples may lead to different estimates about a given population – this concept is known as sampling variability.

7.17 The learner will be able to discuss different types of studies: sample surveys, observational studies and designed experiments.

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7.18 Design a plan and collect data on the basis of above knowledge.

Describing data graphically and numerically

Facilitate the learner to:

7.19 Understand the different types of data: categorical: nominal or ordinal

numerical: discrete or continuous.

7.20 Be able to discuss the effectiveness of different displays in representing the findings of a statistical investigation (pie charts, histograms, stem and leaf plots).

7.21 The learner will be able to use histograms (equal intervals) to display data.

7.22 the learner will understand and be able to compute:-

- mean, median, mode to measure central tendency;
- range and standard deviation (use a calculator to calculate standard deviation) to measure variability.

7.23 The learner will be able to, by reference to histograms, describe a distribution of data in terms of symmetry and skewness.

7.24 The learner will be able to discuss the limitations or merits of mean, median and mode for measuring central tendency with symmetric data and with skewed data.

7.25 Understand what bivariate data is and determine the relationship between variables using scatterplots.

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11. Assessment

11a. Assessment Techniques

Continuous Assessment (proctored): 30%
Final Examination: 50%
Multiple Choice Questions (MCQ): 20%

11b. Mapping of Learning Outcomes to Assessment Techniques

In order to ensure that the learner is facilitated to demonstrate the achievement of all learning outcomes from the component specification; each learning outcome is mapped to an assessment technique(s). This mapping should not restrict an assessor from taking an integrated approach to assessment. If a Learning Outcome is be assessed by MCQ this must happen irrespective if the Learning Outcome is being assessed also in another form of assessment. Other than MCQs if there is a choice of assessment technique this choice should be made locally.

Learning Outcome	Assessment Technique
2. NUMBER	
2.1 Master the operations of addition, multiplication, subtraction and division in the N, Z, Q, R, domains. Represent these numbers on a number line. Understand absolute value as a measure of distance on the number line.	MCQ
2.2 Be able to make basic calculations without any errors, with and without the use of a calculator. Verify the accuracy of these calculations using estimates and approximations.	MCQ
2.3 Convert fractions to percentages, and numbers to scientific notation and calculate percentage error.	MCQ
2.4 Solve practical problems by choosing the correct formula(e) to calculate the area and perimeter of a square, rectangle, triangle, and circle, giving the answer in the correct form and using the correct units.	MCQ
2.5 Solve practical problems by choosing the correct formula(e), to calculate the volume/capacity and surface area of a cube, cylinder, cone, and sphere, giving the answer in the correct form and using the correct terminology	MCQ
2.6 Use the trapezoidal rule to approximate area.	Exam
2.7 Solve problems using the rules for indices and the rules for logarithms.	MCQ/Exam
2.8 Demonstrate a fundamental understanding of binary numbers. Represent a number as a binary number. Perform binary addition. Convert from binary to base 10 and base 10 to binary.	MCQ
2.9 Understand the concept of a complex number and illustrate their representation on an Argand diagram, be able to add, subtract and multiply complex numbers and calculate and interpret the modulus of a complex number.	MCQ/Exam
3 SET THEORY AND LOGIC	
3.1Use the language of set theory appropriately including: universal set, subsets, sets N, Z, Q, R, C and ø, finite and infinite sets, and cardinal number of a set.	CA/Exam
3.2 Explain the basic operations on sets including union, intersection, complement, symmetric difference, Cartesian product, and power set.	CA/Exam
3.3 Use Venn diagrams of two and three sets to represent relationships between sets.	CA/Exam
3.4 Define the Boolean operations AND, NOT, OR and XOR.	CA/Exam

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3.5 Define propositions/statements .	CA/Exam
3.6 Define the truth tables for the compound statements AND, NOT, OR and XOR.	CA/Exam
3.7 Use truth tables to establish logical equivalences for example De Morgan's Laws.	CA/Exam
3.8 Explain the relationship between logical equivalences and set identities.	CA/Exam
4 ALGEBRA	
4.1 Distinguish between an expression and an equation.	MCQ
4.2 Evaluate, expand and simplify algebraic expressions.	MCQ/Exam
4.3 Transpose formulae and perform arithmetic operations on polynomials and rational algebraic expressions.	MCQ/Exam
4.4 Multiply linear expressions to produce quadratics and cubics.	MCQ/Exam
4.5 Reduce quadratic expressions to products of linear expressions through the use of inspection to determine the factors. Use this to solve quadratic equations.	MCQ/Exam
4.6 Solve quadratic equations with real and complex roots by factorisation or formula. (see Functions 5.5) Solve cubic equations with at least one integer root.	Exam
4.7 Solve linear inequalities.	MCQ/Exam
4.8 Find a solution, if it exists, for simultaneous linear equations with 2 and 3 unknowns and interpret the results.	Exam
5 FUNCTIONS AND CALCULUS	
5.1 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.	CA/Exam
5.2 Use mathematical modelling to investigate the relationship between two variables	CA/Exam
5.3 Graph linear, quadratic, and cubic functions, and use these graphs to solve equations $f(x) = 0$, $f(x) = k$ and $f(x) = g(x)$.	CA/Exam
5.4 Define and graph simple exponential, logarithmic, and trigonometric functions.	CA/Exam
5.5 Understand growth/decay characteristics of different types of functions	CA/Exam
5.5 Complete the square for a quadratic function and hence determine its roots and turning point. (see Algebra 4.5)	CA/Exam
5.6 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.	CA/Exam
5.7 Understand how a derivative arises as a limit from looking for tangent lines or rates of change.	CA/Exam
5.8 Differentiate the following types of function: polynomial, trigonometric, rational power, exponential and logarithmic.	CA/Exam
5.9 Use the sum, product and quotient formulas for differentiation and the chain rule to differentiate functions that are a composition of several functions.	CA/Exam
5.10 Use derivatives to calculate tangent lines, rates of changes, maxima and minima, and whether functions are increasing or decreasing.	CA/Exam
5.11 Understand that the definite integral of a positive function defines the area under a curve and that the Fundamental Theorem of Calculus	CA/Exam

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reduces integration to finding anti-derivatives/indefinite integrals.	
5.12 Be able to find the anti-derivative of polynomials, exponential, and trigonometric functions and linear combinations of these.	CA/Exam
5.13 Be able to find the area under such positive curves.	CA/Exam
5.14 Understand that a definite integral also gives the average of a function over an interval multiplied by the length of the interval and hence find average values.	CA/Exam
SYNTHETIC GEOMETRY	
Know the statement of, and be able to solve problems using, the following theorems:	
6.1 Theorem 1: Vertically opposite angles are equal in measure. Proof required	CA/Exam
6.2 Theorem 2: Isosceles triangle: In an isosceles triangle the angles opposite the equal sides are equal. (ii) Conversely, if the two angles are equal, then the triangle is isosceles.	CA/Exam
6.3 Theorem 3: Alternate angles: Suppose that A and D are on opposite sides of the line BC. If $\|\angle ABC\| = \|\angle BCD\|$, then AB $\|\|$ CD. In other words, if a transversal makes equal alternate angles on two lines, then the lines are parallel. Conversely, if AB $\|\|$ CD, then $\|\angle ABC\| = \|\angle BCD$. In other words, if two lines are parallel, then any transversal will make equal alternate angles with them. Proof required	CA/Exam
6.4 Theorem 4: The angles in any triangle add to 180 degrees. Proof required	CA/Exam
6.5 Theorem 5: Corresponding Angles: Two lines are parallel if and only if for any transversal, corresponding angles are equal.	CA/Exam
6.6 Theorem 6: Each exterior angle of a triangle is equal to the sum of the interior opposite angles.	CA/Exam
6.7 Theorem 7: (i) In Δ ABC, suppose that $\|AC\| > \|AB\|$. Then $\|\angle ABC\| > \|\angle ACB\|$. In other words, the angle opposite the greater of two sides is greater than the angle opposite the lesser side. (ii) Conversely, if $\|\angle ABC\| > \|\angle ACB\|$, then $\|AC\| > \|AB\|$. In other words, the side opposite the greater of two angles is greater than the side opposite the lesser angle.	CA/Exam
6.8 Theorem 8: Two sides of a triangle are together greater than the third.	CA/Exam
6.9 Theorem 9: In a parallelogram, opposite sides are equal, and opposite angles are equal.	CA/Exam
6.10 Theorem 10: The diagonals of a parallelogram bisect each other.	CA/Exam
6.11 Theorem 11: If three parallel lines cut off equal segments on some transversal line, then they will cut off equal segments on any other transversal.	CA/Exam
6.12 Theorem 12: Let Δ ABC be a triangle. If a line l is parallel to BC and cuts [AB] in the ratio s : t, then it also cuts [AC] in the same ratio. Know the proposition that if two triangles Δ ABC and Δ A'B'C' have $\|\angle A\| = \|\angle A'\|$, and $\|A'B'\|/\|AB\| = \|A'C'\|/\|AC\|$, then they are similar. Proof required	CA/Exam
6.13 Theorem 13: If two triangles Δ ABC and Δ A'B'C' are similar, then their sides are proportional in order.	CA/Exam
6.14 Theorem 14: Pythagoras: In a right angle triangle the square of the hypotenuse is the sum of the squares of the other two sides. Proof required	CA/Exam
6.15 Theorem 15: Converse to Pythagoras: If the square of one side of a triangle is the sum of the squares of the other two, then the angle opposite the first side is a right angle.	CA/Exam

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6.16 Theorem 16: For a triangle, base times height does not depend on the choice of base.	CA/Exam
6.17 Theorem 17: A diagonal of a parallelogram bisects the area.	CA/Exam
6.18 Theorem 18: The area of a parallelogram is the base by the height.	CA/Exam
6.19 Theorem 19: The angle at the centre of a circle standing on a given arc is twice the angle at any point of the circle standing on the same arc.	CA/Exam
6.20 Theorem 20: (i) Each tangent is perpendicular to the radius that goes to the point of contact. (ii) If P lies on the circle s, and a line l through P is perpendicular to the radius to P, then l is tangent to s.	CA/Exam
6.21 Theorem 21: The perpendicular from the centre of a circle to a chord bisects the chord.	CA/Exam
6.22 Prove theorems 1, 3, 4, 12, 14.	CA/Exam
CO-ORDINATE GEOMETRY	
6.23 Work with linear equations ax + by + c =0.	CA/Exam
6.24 Solve problems involving slope of a line to include investigating parallel and perpendicular lines.	CA/Exam
6.25 Solve problems involving midpoint and length of a line segment.	CA/Exam
6.26 Recognise that (x-h)^2 + (y-k)^2 = r^2 represents the relationship between the x and y co-ordinates of points on a circle with centre (h, k) and radius r.	CA/Exam
TRIGONOMETRY	
6.27 Understand the concepts of degree and radian measure.	CA/Exam
6.28 Define sin θ, cos θ, tan θ, using right angled triangles and using the unit circle.	CA/Exam
6.29 Work with trigonometric ratios in root form.	CA/Exam
6.30 Solve problems involving the area of a triangle using the formula area = ½ab sin Θ	CA/Exam
6.31 Solve practical problems using trigonometric formulae and terminology, including the sine, cosine and tangent ratios for right angled triangles.	CA/Exam
6.32 Solve practical problems using the Sine Rule and Cosine Rule.	CA/Exam
COUNTING	
7.1 List outcomes of an experiment.	CA/Exam
7.2 Apply the fundamental principle of counting (that if one event has m possible outcomes and a second independent event has n possible outcomes, then there are m x n total possible outcomes for the two events together).	CA/Exam
7.3 Count the arrangements of n distinct objects (n!).	CA/Exam
7.4 Count the number of ways of arranging r objects from n distinct objects.	CA/Exam
7.5 Count the number of ways of selecting r objects from n distinct objects.	CA/Exam
PROBABILITY	
7.6 Recognise that probability is a measure on a scale of 0-1 of how likely an event is to occur.	CA/Exam
7.7 Engage in discussions about the purpose of probability.	CA/Exam
7.8 Associate the probability of an event with its long run relative frequency .	CA/Exam
7.9 Understand the concepts and be able to calculate probabilities by counting equally likely outcomes	CA/Exam

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7.10 Understand the concepts and be able to calculate compound probabilities of independent events and of mutually exclusive events	CA/Exam
STATISTICAL REASONING AND DATA COLLECTION	
7.11 Engage in discussions about the purpose of statistics and recognise misconceptions and misuses of statistics.	CA/Exam
7.12 Discuss populations and samples.	CA/Exam
7.13 Recognise the importance of representativeness so as to avoid biased samples and decide to what extent conclusions can be generalised from a sample to a population.	CA/Exam
7.14 Understand how to select a sample using Simple Random Sampling.	CA/Exam
7.15 Understand that randomness and representativeness are not the same.	CA/Exam
7.16 Recognise that not every sample is the same and that different samples may lead to different estimates about a given population – this concept is known as sampling variability.	CA/Exam
7.17 Discuss different types of studies: sample surveys, observational studies and designed experiments.	CA/Exam
7.18 Design a plan and collect data on the basis of above knowledge.	CA/Exam
DESCRIBING DATA GRAPHICALLY AND NUMERICALLY	
7.19 Understand the different types of data: categorical: nominal or ordinal numerical: discrete or continuous.	CA/Exam
7.20 Discuss the effectiveness of different displays in representing the findings of a statistical investigation (pie charts, histograms, stem and leaf plots).	CA/Exam
7.21 Use histograms (equal intervals) to display data.	CA/Exam
7.22 Understand and be able to compute:- - mean, median, mode to measure central tendency; - range and standard deviation (use a calculator to calculate standard deviation) to measure variability.	CA/Exam
7.23 By reference to histograms, describe a distribution of data in terms of symmetry and skewness.	CA/Exam
7.24 Discuss the limitations or merits of mean, median and mode for measuring central tendency with symmetric data and with skewed data.	CA/Exam
7.25 Understand what bivariate data is and determine the relationship between variables using scatterplots.	CA/Exam

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11c. Guidelines for Assessment Activities

The assessor is required to devise assessment briefs and marking schemes/examination papers, marking schemes and outline solutions for the assignments and examination. It is hoped to have a centrally devised MCQ available. In devising the assessment briefs/examination papers, care should be taken to ensure that the learner is given the opportunity to show evidence of achievement of ALL the learning outcomes. Assessment briefs may be designed to allow the learner to make use of a wide range of media in presenting assessment evidence, as appropriate. Quality assured procedures must be in place to ensure the reliability of learner evidence.

Assessment technique(s) including weighting(s)
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.

Multiple Choice Questions (MCQ)	**20%**
1 Hour	
MCQ on Units 2 and 4 only. MCQ is of one hour's duration with a pass threshold of 80%. **Pass in the MCQ is mandatory for overall pass of this award and a pass is 80%.**	

Continuous Assessment (proctored) Assignments (2)	**30% (2 x 15%)**
Assignment 1 - 15%	
2 Weeks preparation period where the course is taught over an academic year or appropriate pro rata time period if the course is taught over a different duration. Proctored assessment of 1 hour.	
The brief for the first assignment will cover learning outcomes from Unit 7 and may take the form of a project or a proctored assessment*	
Assignment 2 - 15%	
2 Weeks preparation period where the course is taught over an academic year or appropriate pro rata time period if the course is taught over a different duration. Proctored assessment of 1 hour.	
The brief for the second assignment will cover learning outcomes from Unit 3, 5 or 6 and will take the form of a proctored assessment*	
*For example: a tutorial sheet could consist of questions for each unit. Students are given a suitably large bank of tutorial questions to do outside of class time. Summative assessment is given under supervised conditions using questions from the bank of tutorial questions.	

Examinations (2)	**50% (2 x 25%)**
2 Hours Each	
Examination Paper 1: 10 short answer questions from Unit 3 and Unit 6 (1% each question) 3 long answer questions testing the material from Unit 2, Unit 3 and Unit 6 (5% each question) **Examination Paper 2:** 10 short answer questions from Unit 5 and Unit 7 (1% each question); 3 long answer questions testing the material from Unit 4, Unit 5 and Unit 7 (5% each question).	

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12. Grading

Distinction:	80% - 100%
Merit:	65% - 79%
Pass:	50% - 64%
Unsuccessful:	0% - 49%

At levels 4, 5 and 6 major and minor awards will be graded. The grade achieved for the major award will be determined by the grades achieved in the minor awards.

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Maths for STEM 5N0556	Learner Marking Sheet Multiple Choice Questions (20%)

Learner's Name: _____ Learner's PPSN: _____

Assessment Criteria	Maximum Mark	Learner Mark
Units 2 and 4 Achievement with mastery of the learning outcomes in Units 2 and 4 *Note: A minimum mark of 160 is required on this Marking Sheet*	200	
Total Mark	**200**	

Assessor's Signature: _____ Date: _____

External Authenticator's Signature: _____ Date: _____

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Maths for STEM 5N0556	Learner Marking Sheet Assignments (30%)

Learner's Name: _____ Learner's PPSN: _____

Assessment Criteria	Maximum Mark	Learner Mark
In order to demonstrate that they have reached the standards of knowledge, skill and competence identified in the required learning outcomes of units 3,5,6,7		
Assignment 1 Unit 7	150	
Assignment 2 Units	150	
Total Mark	**300**	

Assessor's Signature: _____ Date: _____

External Authenticator's Signature: _____ Date: _____

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Maths for STEM 5N0556	Learner Marking Sheet Examination (50%)

Learner's Name: _____ Learner's PPSN: _____

Assessment Criteria		Maximum Mark	Learner Mark (Exam 1) Units 2,3,6	Learner Mark (Exam 2) Units 4,5,7
Section A: Short Questions Answer all questions Question No.:				
	1	10		
	2	10		
	3	10		
	4	10		
	5	10		
	6	10		
	7	10		
	8	10		
	9	10		
	10	10		
	Subtotal	100		
Section B: Long Questions Answer all questions Question No.:				
	1	50		
	2	50		
	3	50		
	Subtotal	150		
	Total Mark	250		
		500		

Assessor's Signature: _____ Date: _____

External Authenticator's Signature: _____ Date: _____

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