Government of **Western Australia**
School Curriculum and Standards Authority

DRAFT FOR CONSULTATION

MATHEMATICS METHODS

ATAR course

Year 11 syllabus for teaching from 2028

Acknowledgement of Country

Kaya. The School Curriculum and Standards Authority (the Authority) acknowledges that our offices are on Whadjuk Noongar boodjar and that we deliver our services on the country of many traditional custodians and language groups throughout Western Australia. The Authority acknowledges the traditional custodians throughout Western Australia and their continuing connection to land, waters and community. We offer our respect to Elders past and present.

Important information

As part of the Western Australian Certificate of Education (WACE) Refreshment, the School Curriculum and Standards Authority (the Authority) has revised the course rationale and aims, and updated the General Capabilities to create clearer connections with the syllabus content.

This syllabus is effective from 1 January 2028.

Users of this syllabus are responsible for checking its currency.

Syllabuses are formally reviewed by the Authority on a cyclical basis, typically every five years.

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Contents

Rationale

The Mathematics Methods ATAR course covers the study of calculus and statistical analysis in applied and theoretical contexts. It focuses on developing students' ability to use mathematical concepts and techniques to solve problems, analyse data and model real-world phenomena.

The course focuses on the algebraic and graphical representations of functions, algebraic techniques and the use of matrices. It extends trigonometry to include functions and the unit circle, formalises probability and introduces differential calculus through the exploration of rates of change.

By studying this course, students develop a strong foundation in mathematical reasoning, critical thinking and analytical problem-solving. They gain fluency in manipulating algebraic expressions, interpreting mathematical models and using statistical methods and probability techniques to draw meaningful conclusions from data. The course fosters students' ability to communicate mathematical arguments clearly and logically.

The mathematical skills and concepts covered in the course have broad applications in daily life and various professional fields. Students apply their understanding of probability to make informed decisions based on data analysis and real-world uncertainties. Their developing knowledge of functions and calculus helps in solving practical problems related to measurement, growth rates and periodic phenomena.

The Mathematics Methods ATAR course provides a strong foundation for students intending to pursue tertiary studies in engineering, computer science, physics, economics, health sciences and data analytics. Careers in areas such as actuarial science, medicine, finance and research heavily depend on mathematical reasoning and statistical analysis, making the study of Mathematics Methods highly beneficial.

Aims

The Mathematics Methods ATAR course aims to develop students':

- understanding of concepts and techniques drawn from algebra, functions, calculus, probability and statistics
- ability to apply mathematical knowledge to solve applied and theoretical problems
- proficiency in reasoning and interpretation within mathematical and statistical contexts
- capacity to communicate findings clearly and systematically, using precise and appropriate mathematical and statistical language
- confidence to select and use digital tools appropriately and efficiently to support problem-solving and data analysis.

Organisation

This course is organised into a Year 11 syllabus and a Year 12 syllabus. The cognitive complexity of the syllabus content increases from Year 11 to Year 12.

Structure of the syllabus

The Year 11 syllabus is divided into two units, each of one semester duration, which are typically delivered as a pair. The notional time for each unit is 55 class contact hours.

Organisation of content

Unit 1

Contains three topics:

- Linear relationships and matrix methods
- Algebraic techniques
- Functions, relations and graphs.

Unit 2

Contains three topics:

- Trigonometric functions
- Probability
- Introduction to differential calculus.

Each unit includes:

- a unit description – a short description of the focus of the unit
- learning outcomes – a set of statements describing the learning expected as a result of studying the unit
- unit content – the content to be taught and learned.

Role of technology

It is assumed that students will be taught this course with an extensive range of technological applications and techniques. If appropriately used, these technologies have the potential to enhance the teaching and learning of the course; however, students also need to continue to develop skills that do not depend on technology. The ability to choose when or when not to use some form of technology, and being able to work flexibly with technology, are important skills in this course.

Progression from the Years 7–10 curriculum

The Mathematics Methods ATAR course extends students' understanding, fluency, problem-solving and reasoning from all three strands of the Years 7–10 Mathematics curriculum. Students extend their use of the mathematical modelling process to investigate and understand real-world phenomena and solve problems in applied and theoretical contexts. To study the Mathematics Methods ATAR course, completion of a selection of topics from the Year 10 Mathematics Optional content may be beneficial.

Representation of the General Capabilities

The General Capabilities encompass the knowledge, skills, behaviours and dispositions that will support students to live and work successfully now and into the future. They are not assessed unless identified within the specified unit content. Teachers should find opportunities to incorporate the following General Capabilities into the teaching and learning program for the Mathematics Methods ATAR course.

Critical and creative thinking

Students identify and clarify information from a range of sources, including visual information and digital sources. They identify the relevant aspects of a concept or problem, understanding that a single mathematical process can be used in seemingly different situations and that approaches may change depending on the context or nature of the problem. Students draw conclusions and make choices when completing tasks by connecting evidence from within and across the mathematical content to provide reasons and evaluate arguments for choices made.

Digital literacy

Students use appropriate digital tools to support the development of mathematical understanding and to apply mathematical knowledge to a range of problems. They use technologies aligned with areas of work they may be involved with such as statistical and graphical analysis, generation of algorithms, algebraic manipulation and complex calculations. Students use digital tools to make connections between mathematical theory, practice and application.

Literacy

Students develop literacy skills and strategies that enable them to express, interpret and communicate complex mathematical information, ideas and processes. Mathematics provides a specific and rich context for students to develop their ability to read, write, visualise and talk about complex situations involving a range of mathematical ideas. They can apply and further develop their literacy skills and strategies by shifting between verbal, graphical, numerical and symbolic forms of representing problems to formulate, understand and solve problems, and communicate results. Students learn to communicate their findings in different ways, using multiple systems of representation to illustrate the relationships they have observed or constructed.

Numeracy

Students develop their numeracy skills at a more sophisticated level, making decisions about the relevant mathematics to use, following through with calculations, selecting appropriate methods and being confident of their results. This course contains topics that will equip students for the increasing demands of the information age, developing the skills of critical evaluation of numerical information. They enhance their numerical operation skills via engagement with number sequences, trigonometric and probability calculations, algebraic relationships and the development of calculus concepts.

Addressing the other General Capabilities

Although the following General Capabilities have not been identified as a focus in the Mathematics Methods ATAR Year 11 syllabus, teachers may find opportunities to incorporate them into the teaching and learning program.

- Ethical understanding
- Intercultural understanding
- Personal and social capability

Such opportunities may occur through the application of different contexts, pedagogical practices and/or assessment strategies that relate to the syllabus as part of the teaching and learning program.

Summary representation of the General Capabilities in the Mathematics Methods ATAR course

The unit content and assessment types for this course provide students with the opportunity to develop the General Capabilities summarised in the table below.

Year	Course	Course type	General Capabilities						
			CCT	DL	EU	IU	L	N	PSC
Year 11	Mathematics Methods (AEMAM)	ATAR	✓	✓			✓	✓	
Year 12	Mathematics Methods (ATMAM)	ATAR	✓	✓			✓	✓	

Key
CCT: Critical and creative thinking, DL: Digital literacy, EU: Ethical understanding, IU: Intercultural understanding, L: Literacy, N: Numeracy, PSC: Personal and social capability

Representation of the Cross-curriculum Priorities

The Cross-curriculum Priorities address the contemporary issues that students face in a globalised world. Teachers may find opportunities to incorporate them into the teaching and learning program for the Mathematics Methods ATAR course. The Cross-curriculum Priorities are not assessed unless they are identified within the specified unit content.

Aboriginal and Torres Strait Islander histories and cultures

Mathematics courses value the histories, cultures, traditions and languages of Aboriginal and Torres Strait Islander peoples and their past and ongoing contributions to contemporary Australian society and culture. Through the study of mathematics within relevant contexts, students develop an understanding and appreciation of the diversity of Aboriginal and Torres Strait Islander peoples' histories and cultures.

Asia and Australia's engagement with Asia

There are strong social, cultural and economic reasons for Australian students to engage with the countries of Asia and with the past and ongoing contributions made by the peoples of Asia in Australia. It is through the study of mathematics in an Asian context that students engage with Australia's place in the region. By analysing relevant data, students further develop an understanding of the diverse nature of Asia's environments and traditional and contemporary cultures.

Sustainability

Each of the mathematics courses provides students with the opportunity to develop informed and reasoned points of view, discuss issues, research and problem-solve. Teachers are therefore encouraged to select contexts for discussion that are connected with sustainability. Through the analysis of data, students have the opportunity to research and discuss sustainability and learn the importance of respecting and valuing a wide range of world perspectives.

Unit 1

Unit description

The unit has three topics:

- Linear relationships and matrix methods includes manipulation and analysis of linear functions, including parallel and perpendicular lines, and introduces matrix algebra and the use of matrices to solve simultaneous equations.
- Algebraic techniques uses concepts related to indices, quadratic and cubic functions, and introduces further techniques required for a successful introduction to the study of calculus.
- Functions, relations and graphs introduces students to the distinguishing features of functions and relations, exploring how graphs can be transformed and used to solve related equations.

Classroom access to the technology necessary to support the computational and graphical aspects of the topics in this unit is assumed.

Learning outcomes

By the end of this unit, students:

- demonstrate the concepts and techniques used in algebra, matrices, functions and graphs
- solve problems using algebra, matrices, functions and graphs
- apply reasoning skills in the context of algebra, matrices, functions and graphs
- interpret and evaluate mathematical information and ascertain the reasonableness of solutions to problems
- communicate their arguments and strategies when solving problems.

Unit content

This unit includes the knowledge, understandings and skills described below.

Topic 1.1: Linear relationships and matrix methods

Lines and linear relationships

1.1.1 obtain the equation and/or sketch the graph of a straight line from given information, including points, intercepts, gradient, table of values or relationships with parallel and perpendicular lines

1.1.2 solve a system of linear equations in two variables algebraically, graphically and using digital tools

Matrices and applications

1.1.3 use different types of matrices (row, column, square, zero, identity) to represent information from real-world situations and use standard notation to identify matrix dimensions and elements

1.1.4 add and subtract matrices and multiply a matrix by a scalar in applied situations

1.1.5 multiply matrices to solve real-world problems and interpret the resulting matrix in the given context

1.1.6 derive and solve linear equations from the addition, subtraction or multiplication of matrices to find unknown variables

1.1.7 calculate the determinant and inverse of a 2 × 2 matrix

1.1.8 use the inverse of a 2 × 2 matrix, A to solve matrix equations of the form AX = B, where X and B are column matrices

1.1.9 represent a system of linear equations in two variables in matrix form and use the inverse matrix to solve this system

Topic 1.2: Algebraic techniques

Indices

1.2.1 simplify algebraic products and quotients, including those with integer and fractional indices, and convert between index and radical/surd form

1.2.2 simplify numerical expressions involving surds, including rationalising the denominator of fractions of the form $\frac{m}{\sqrt{n}}$

Quadratic and cubic expressions

1.2.3 expand factors to obtain quadratic and cubic expressions

1.2.4 factorise monic and non-monic quadratic expressions using a range of strategies

1.2.5 solve monic and non-monic quadratic equations, using methods including completing the square and applying the quadratic formula, recognising the role of the discriminant in determining the nature of the solution

1.2.6 solve factorised cubic equations using the null factor theorem

1.2.7 add, subtract, multiply and divide algebraic fractions, including those with quadratic numerators and/or denominators that can be factorised

Topic 1.3: Functions, relations and graphs

Functions and relations

1.3.1 define a relation as any set of ordered pairs linking inputs to outputs, identify a function as a special type of relation involving one output for each input and use the vertical line test to verify whether a given graph represents a function

1.3.2 use function notation

Graphs of functions and relations

1.3.3 determine and describe the domain and range of a function using appropriate notation

1.3.4 sketch and describe the graphs of quadratic functions in the form $y = x^2$, $y = ax^2 + bx + c$, $y = a(x - h)^2 + k$, $y = a(x - d)(x - e)$, including shape, axis of symmetry, turning point, and intercept/s, using digital tools as appropriate

1.3.5 sketch and describe the graphs of $y = x^3$, $y = a(x-b)^3$ and $y = k(x-a)(x-b)(x-c)$, including shape, intercept/s and behaviour of the function as $x \to \pm\infty$ using digital tools as appropriate

1.3.6 solve linear, quadratic and cubic equations graphically, in situations where the solution/s can be interpreted as roots, intersections with the line $y = k$, or the point/s of intersection between two curves

1.3.7 sketch a range of polynomial functions using digital tools and identify and describe key features, such as intercepts, turning points, local and global minimum and/or maximum values and behaviour of the function as $x \to \pm\infty$

1.3.8 sketch and compare the graphs of the relation $y^2 = x$ and the square root function $y = \sqrt{x}$

1.3.9 sketch the graph of the rectangular hyperbola function $y = \frac{1}{x}$, identify asymptotes and behaviour of the function as $x \to \pm\infty$

1.3.10 sketch a piecewise function constructed from known functions, including examples of continuous and discontinuous cases

1.3.11 determine the continuity of a piecewise function by evaluating function values at interval boundaries

1.3.12 describe and apply translations $y = f(x) + a$ or $y = f(x-b)$ and dilations $y = cf(x)$ or $y = f(dx)$, and reflections when $c < 0$ or $d < 0$ to the graphs of known functions

1.3.13 sketch the graph of a circle given in the form $x^2 + y^2 = r^2$ or $(x-a)^2 + (y-b)^2 = r^2$ and identify the shape, centre and radius from the graph and/or equation

Unit 2

Unit description

The unit has three topics:

- Trigonometric functions extends the applications of trigonometric measurement to non-right triangles and introduces the unit circle, radian measure and the graphs of the trigonometric functions. Trigonometric functions and relationships are used to solve a range of applied problems.
- Probability introduces the formal notation and language of probability. Students use weighted tree diagrams and identify independent events in a range of contexts.
- Introduction to differential calculus includes the introduction of rates and average rates of change, followed by the key concept of the derivative as an 'instantaneous rate of change'. These concepts are reinforced numerically, by calculating difference quotients both geometrically as slopes of chords and tangents, and algebraically. Calculus is developed to study the derivatives of polynomial functions, with simple application of the derivative to curve sketching, the calculation of slopes and equations of tangents, the determination of instantaneous velocities and the solution of optimisation problems.

Classroom access to the technology necessary to support the computational and graphical aspects of the topics in this unit is assumed.

Learning outcomes

By the end of this unit, students:

- demonstrate the concepts and techniques used in trigonometric functions, probability and calculus
- solve problems in trigonometric functions, probability and calculus
- apply reasoning skills in trigonometric functions, probability and calculus
- interpret and evaluate mathematical information and ascertain the reasonableness of solutions to problems
- communicate arguments and strategies when solving problems.

Unit content

This unit builds on the content covered in Unit 1.

This unit includes the knowledge, understandings and skills described below.

Topic 2.1: Trigonometric functions

Trigonometric measurement

2.1.1 use trigonometric ratios and Pythagoras' theorem to determine exact sine, cosine and tangent values for 30°, 45° and 60°

2.1.2 establish and use the sine rule (ambiguous case included), cosine rule and sine area rule to solve applied problems involving non-right-angled triangles in two- and three-dimensions

Unit circle relationships

2.1.3 use the unit circle to define sine, cosine and tangent for an angle in the first quadrant

2.1.4 establish and use the Pythagorean identity

2.1.5 use the unit circle to determine the sine, cosine and tangent for any angle

2.1.6 establish and use Even-Odd identities and Complementary identities for sine and cosine based on positional relationships on the unit circle

2.1.7 define radian measure as the ratio of arc length to radius, convert between degrees and radians, and determine the exact radian/degree equivalents for standard unit circle angles

2.1.8 use symmetry and quadrants to determine exact sine, cosine and tangent values for integer multiples of $\frac{\pi}{6}$ and $\frac{\pi}{4}$

2.1.9 sketch the functions $y = a\sin bx, y = a\cos bx$, and $y = a\tan bx$ on extended domains, identifying the amplitude and period of each

2.1.10 sketch and interpret phase changes for the graphs of $y = \sin(x - c)$ and $y = \cos(x - c)$, including the relationships $\sin\left(x + \frac{\pi}{2}\right) = \cos x$ and $\cos\left(x - \frac{\pi}{2}\right) = \sin x$

2.1.11 use the unit circle, known identities, graphs and digital tools as appropriate to solve trigonometric equations that can be reduced to linear form, including multiple solutions for a specified domain

2.1.12 use trigonometric functions to model simple situations in context and use them to solve applied problems

Topic 2.2: Probability

2.2.1 use probability notation for events, including:
- $\mathrm{P}(\bar{A})$ or $\mathrm{P}(A')$ for the complement of an event A
- $\mathrm{P}(A \cap B)$ and $\mathrm{P}(A \cup B)$ for the intersection and union respectively of events A and B and recognise mutually exclusive events

2.2.2 solve problems related to union and intersection, including the use of the addition rule $\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A \cap B)$ and mutually exclusive events

2.2.3 use language that indicates conditional probability and the formula $P(A|B) = \frac{P(A \cap B)}{P(B)}$

2.2.4 use weighted tree diagrams, two-way tables and Venn diagrams to solve problems involving two events, including the use of the multiplication rule, $\mathrm{P}(A \cap B) = \mathrm{P}(A|B)\mathrm{P}(B)$

2.2.5 identify dependent and independent events, recognising that $\mathrm{P}(A \cap B) = \mathrm{P}(A)\mathrm{P}(B)$ and $\mathrm{P}(A|B) = \mathrm{P}(A)$ for independent events, and calculate probabilities as appropriate

Topic 2.3: Introduction to differential calculus

The concept of the derivative

2.3.1 determine the average rate of change of y with respect to x for a polynomial function, $y = f(x)$ over an interval, as $\frac{\Delta y}{\Delta x} = \frac{f(b)-f(a)}{b-a}$ and interpret this graphically as the gradient of the chord joining the end points of the interval

2.3.2 for a function $y = f(x)$, use the limiting chord process, $\frac{\delta y}{\delta x} = \lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$, to determine a numerical approximation for the rate of change at a given point (instantaneous rate of change), where δx and δy represent small changes in the variables x and y, respectively

2.3.3 represent the instantaneous rate of change at a point graphically as the gradient of the tangent to the curve at the given point, and identify intervals where the gradient of the tangent line will be positive, negative or zero

2.3.4 define the gradient function $f'(x) = \lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$ as the derivative and use Leibniz notation $\frac{dy}{dx}$, or y', to represent the derivative of y with respect to x and $\frac{d}{dx}[f(x)]$ or $f'(x)$ to represent the derivative of $f(x)$

2.3.5 use differentiation by first principles to determine the derivative function for functions, such as $y = ax + b, y = ax^2 + bx, y = ax^3$ and $y = \frac{1}{x}$

2.3.6 use the formula $\frac{d}{dx}(x^n) = nx^{n-1}$ to differentiate power functions for real values of n

2.3.7 use the linearity properties of the derivative, $\frac{d}{dx}[f(x) \pm g(x)] = \frac{d}{dx}f(x) \pm \frac{d}{dx}g(x)$ and $\frac{d}{dx}[cf(x)] = c\frac{d}{dx}f(x)$ to differentiate functions

Applications of the derivative

2.3.8 determine the gradient, the equation of the tangent and the equation of the normal to the curve at a given point

2.3.9 sketch curves of polynomials, where the location and nature of stationary points (local maxima and minima) can be determined, and identify other features, such as intercepts, global maxima and minima and behaviour as $x \to \pm\infty$

2.3.10 sketch the graph of $y = f'(x)$ given the graph of $y = f(x)$

2.3.11 interpret and use a displacement-time graph or function to solve applied problems in linear motion, by recognising velocity as the slope of the tangent or as the first derivative of displacement with respect to time

2.3.12 solve optimisation problems by locating maximum and/or minimum values using the derivative, for situations that can be modelled using a power function

Assessment

Assessment is an integral part of teaching and learning that in the senior secondary years:

- provides evidence of student achievement
- identifies opportunities for further learning
- connects to the standards described for the course
- contributes to the recognition of student achievement.

Assessment for learning (formative) and assessment of learning (summative) enable teachers to gather evidence to support students and make judgements about student achievement. These are not necessarily discrete approaches and may be used individually or together, and formally or informally.

Formative assessment involves a range of informal and formal assessment procedures used by teachers during the learning process to improve student achievement and to guide teaching and learning activities. It often involves qualitative feedback (rather than scores) for both students and teachers, which focuses on the details of specific knowledge and skills that are being learned.

Summative assessment involves assessment procedures that aim to determine students' learning at a particular time; for example, when reporting against the standards or after completion of a unit or units. These assessments should be limited to eight or less and made clear to students through the assessment outline.

Appropriate assessment of student work in this course is underpinned by reference to a set of predetermined course standards. These standards describe the level of achievement required to achieve each grade from A to E. Teachers use these standards to determine how well a student has demonstrated their learning.

Where relevant, higher order cognitive skills (e.g. application, analysis, synthesis and evaluation) and the General Capabilities should be included in the assessment of student achievement in this course. All assessment should be consistent with the requirements identified in the course assessment table.

Assessment should not generate workload or stress that, under fair and reasonable circumstances, would unduly diminish the performance of students.

School-based assessment

The *Western Australian Certificate of Education (WACE) Manual* contains essential information on principles, policies and procedures for school-based assessment that must be read in conjunction with this syllabus.

School-based assessment involves teachers gathering, describing and quantifying information about student achievement.

Teachers design school-based assessment tasks to meet the needs of students. As outlined in the *WACE Manual*, school-based assessment of student achievement in this course must be based on the Principles of Assessment:

- Assessment is an integral part of teaching and learning.
- Assessment should be educative.
- Assessment must be fair.
- Assessment should be designed to meet its specific purpose/s.
- Assessment should lead to informative reporting.
- Assessment should lead to school-wide evaluation processes.
- Assessment should provide significant data for improvement of teaching practices.

The table below provides details of the assessment types and their weighting for the Mathematics Methods ATAR Year 11 syllabus.

Summative assessments in this course must:

- be limited to eight tasks or less
- allow for the assessment of each assessment type at least once over the year/pair of units
- have a minimum value of five per cent of the total school assessment mark
- provide a representative sampling of the syllabus content.

Assessment tasks not administered under test or controlled conditions require appropriate authentication processes.

Assessment table – Year 11

Type of assessment	Weighting
Response Students apply mathematical knowledge and understanding of concepts, techniques and relationships to solve a mix of routine and non-routine questions, demonstrating their interpretation of concepts and results in applied and theoretical contexts. Response tasks can include tests, assignments and multimedia representations.	40%
Investigation Students use the mathematical thinking process to plan, research, conduct and communicate the findings of an investigation. They can investigate problems to identify the underlying mathematics, or select, adapt and apply models and procedures to solve problems. This assessment type provides for the assessment of the mathematical thinking process using course-related knowledge and modelling skills. Evidence can include observation and interview, written work or multimedia presentations.	20%
Examination Students apply mathematical understanding and skills to analyse, interpret and respond to questions and situations. Examinations provide for the assessment of conceptual understandings, knowledge of mathematical facts and terminology, problem-solving skills and the use of algorithms. Examination questions can range from those of a routine nature, assessing lower-level concepts, through to those that require responses at the highest level of conceptual thinking. Examinations are typically conducted at the end of each semester and/or unit. In preparation for Unit 3 and Unit 4, the examination should reflect the examination design brief included in the ATAR Year 12 syllabus for this course. Where a combined assessment outline is implemented, the Semester 2 examination should assess content from both Unit 1 and Unit 2. However, the combined weighting of Semester 1 and Semester 2 should reflect the respective weightings of the course content as a whole.	40%

Teachers are required to use the assessment table to develop an assessment outline for the pair of units (or for a single unit where only one is being studied).

The assessment outline must:

- include a set of assessment tasks
- include a general description of each task
- indicate the unit content to be assessed
- indicate a weighting for each task and each assessment type
- include the approximate timing of each task; for example, the week the task is conducted or the issue and submission dates for an extended task.

Reporting

Schools report student achievement, underpinned by a set of predetermined standards, using the following grades:

Grade	Interpretation
A	Excellent achievement
B	High achievement
C	Satisfactory achievement
D	Limited achievement
E	Very low achievement

The grade descriptions for the Mathematics Methods ATAR Year 11 syllabus are provided in Appendix 1. They are used to support the allocation of grades. They can also be accessed, together with annotated work samples, on the course page of the Authority website (www.scsa.wa.edu.au).

To be assigned a grade, a student must have had the opportunity to complete the education program, including the assessment program (unless the school accepts that there are exceptional and justifiable circumstances).

Refer to the *WACE Manual* for further information about the use of a ranked list in the process of assigning grades.

The grade is determined by reference to the standard, not allocated on the basis of a predetermined range of marks (cut-offs).

Appendix 1 – Grade descriptions Year 11*

A	**Interprets the task, identifies and organises relevant information, and chooses strategies** Identifies and organises relevant information from previous parts of a problem and brings them together to solve additional problems. Selects an appropriate strategy and demonstrates mathematical conventions to solve non-routine, unfamiliar, unstructured and/or multi-step problems. Clarifies an investigative task, identifies the key information and relevant assumptions, and chooses the appropriate mathematics.
	Uses mathematical knowledge and understanding to obtain solutions Completes concise and accurate solutions to mathematical problems set in a variety of applied and theoretical contexts. Navigates between numerical, graphical and symbolic representations appropriately to solve problems in unfamiliar contexts. Uses digital tools and their appropriate functionalities effectively to solve problems in unfamiliar contexts. Applies changed conditions and correctly determines and explains the effect on the solution. Applies comprehensive knowledge and understanding of relevant concepts and relationships to extensively investigate a problem.
	Communicates mathematical reasoning, interprets results and draws conclusions Sets out the steps of the solution in a succinct and logical sequence, including suitable justification and explanation of methods and processes used. Uses mathematical notation, terminology and units correctly, and appropriate rounding consistently. Interprets mathematical results and draws conclusions in the context of the problem. Comprehensively interprets and clearly communicates mathematical findings in the context of an investigation. Identifies the strengths and limitations of an investigation and includes consideration of these in refining the results to draw sensible conclusions.
B	**Interprets the task, identifies and organises relevant information, and chooses strategies** Identifies and organises relevant information for problems involving a few steps or processes. Selects an appropriate strategy and demonstrates mathematical conventions to solve non-routine, familiar and/or partly structured problems. Clarifies an investigative task, identifies the key information and some assumptions, and mostly chooses the appropriate mathematics.
	Uses mathematical knowledge and understanding to obtain solutions Produces mostly accurate and complete solutions for mathematical problems set in applied and theoretical contexts. Navigates between numerical, graphical and symbolic representations appropriately to solve problems in familiar contexts. Uses digital tools and their appropriate functionalities effectively to solve problems in familiar contexts. Applies changed conditions and attempts to determine the effect on the solution. Applies some depth of knowledge and understanding of relevant concepts and relationships to investigate a problem.

	Communicates mathematical reasoning, interprets results and draws conclusions Sets out the steps of the solution in a logical sequence, including some justification and explanation of methods and processes used. Uses mathematical notation, terminology and units correctly most of the time, and uses appropriate rounding. Interprets most mathematical results and draws conclusions in the context of the problem. Interprets and communicates mathematical findings in the context of an investigation. Identifies the strengths and limitations of an investigation.

C	**Interprets the task, identifies and organises relevant information, and chooses strategies** Identifies and extracts key information needed to solve a familiar problem. Selects an appropriate strategy and demonstrates mathematical conventions to solve routine, familiar and/or structured problems. Clarifies an investigative task, identifies the key information, and mostly chooses appropriate mathematics.
	Uses mathematical knowledge and understanding to obtain solutions Produces some accurate and mostly complete solutions to mathematical problems set in applied or theoretical contexts. Recognises and uses numerical, graphical and symbolic representations appropriately to solve routine problems. Uses digital tools and their appropriate functionalities to solve routine problems. Applies changed conditions to determine a solution in routine problems. Applies competent knowledge and understanding of concepts and relationships to investigate a problem.
	Communicates mathematical reasoning, interprets results and draws conclusions Sets out the steps of the solution and supports methods and processes with simple or routine statements. Demonstrates some correct use of mathematical notation, terminology and units, and appropriate rounding. Interprets some mathematical results and draws some conclusions in the context of the problem. Communicates mathematical findings in the context of an investigation. Attempts to identify the limitations of an investigation.

D	**Interprets the task, identifies and organises relevant information, and chooses strategies** Uses given information to solve simple routine problems. Selects inappropriate strategies and/or demonstrates limited mathematical conventions in an attempt to solve familiar problems. Clarifies an investigative task, identifies some key information and chooses some appropriate mathematics.
	Uses mathematical knowledge and understanding to obtain solutions Produces partly accurate and incomplete solutions to mathematical problems set in applied or theoretical contexts. Uses digital tools in an attempt to solve routine problems. Attempts to apply changed conditions to determine a solution in routine problems. Attempts to apply knowledge and understanding of concepts and relationships to investigate a problem.

	Communicates mathematical reasoning, interprets results and draws conclusions Attempts to set out the steps of the solution. Displays limited use of mathematical notation, terminology and units, and appropriate rounding. Displays limited interpretation of mathematical results and conclusions not clearly formulated. Communicates minimal findings from the results of an investigation.

E	Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.

*These grade descriptions will be reviewed at the end of the second year of implementation of this syllabus.

Appendix 2 – Glossary

This glossary is provided to enable a common understanding of the key terms in this syllabus.

Unit 1

Linear relationships and matrix methods

Determinant

The determinant of a 2×2 matrix is a scalar value that is calculated using the elements of the matrix. It is commonly denoted as det **A**. A matrix is singular if det $\mathbf{A} = 0$.

Elements of a matrix

The elements of a matrix are the individual entries in the array. The symbol a_{ij} represents the (i, j) element occurring in the i^{th} row and the j^{th} column of the matrix.

Identity matrix

An identity matrix is a square matrix in which all the elements in the leading diagonal (diagonal that runs from the top left corner to the bottom right corner of the matrix) are 1s and the remaining elements are 0s. Identity matrices are designated by the letter **I**.

Inverse (multiplicative) of a square matrix

The inverse of a square matrix **A** is written as $\mathbf{A}^{-1}$ and has the property that $\mathbf{A}\,\mathbf{A}^{-1} = \mathbf{A}^{-1}\mathbf{A} = \mathbf{I}$. A singular matrix does not have a multiplicative inverse.

Matrix (matrices)

A matrix is a rectangular array of elements displayed in rows and columns. A square matrix has the same number of rows and columns. A zero matrix is a matrix where all elements are zero. A column matrix has only one column and a row matrix has only one row.

Matrix dimensions

The dimensions of a matrix are described by the number of rows and columns. Two matrices are said to have the same dimensions (or size) if they have the same number of rows and columns. An m × n matrix has m rows and n columns.

Algebraic techniques

Discriminant

The discriminant of the quadratic expression $ax^2 + bx + c$ is the value determined by $b^2 - 4ac$. The discriminant informs the number and nature of roots for a quadratic equation.

Null factor theorem

States that if the product of two or more factors is zero, then at least one of the factors must be zero.

Radical

An expression written with a root sign.

Rationalising

Removing the surd (or radical) from the denominator of a fraction.

Surd

An expression written with a root sign that cannot be simplified.

Functions, relations and graphs

Asymptote
A line is an asymptote to a curve if the distance between the line and the curve approaches zero as they 'tend to infinity'.

Continuous
A function that contains no breaks or holes is continuous.

Domain
See Function.

Function
A function f is a special type of relation where for every element x in a set S, there exists a unique element $f(x)$. The set S is called the domain of f and the set of values, $f(x)$ is called the range.

Function notation
A way of writing mathematical functions that shows the relationship between the independent variable x and the dependent variable y using $f(x)$ in place of y.

Global minimum/maximum
The single lowest or highest point across the full domain of a function.

Local minimum/maximum
The lowest or highest point within a restricted region (domain) of a function.

Piecewise function
A piecewise function consists of one or more functions, defined for non-overlapping domains.

Polynomial function
A function that can be written as a sum or difference of terms, where each term contains a variable raised to a whole number power.

Range
See Function.

Vertical line test
A relation between two real variables x and y is a function and $y = f(x)$ for some function f, only if each vertical line, i.e. each line parallel to the y-axis, intersects the graph of the relation in, at most, one point. This test to determine whether a relation is, in fact, a function is known as the vertical line test.

Unit 2

Trigonometric functions

Complementary identities
Complementary identities use the symmetry of the unit circle to determine the value of trigonometric expressions by relating angles to their complement.

Even-odd identities
Even-odd identities use the symmetry of the unit circle to determine the value of trigonometric expressions by relating negative angles to positive angles.

Period of a function
The period of a function $f(x)$ is the smallest positive number p with the property that $f(x+p)=f(x)$ for all x. The functions $\sin x$ and $\cos x$ both have period 2π and $\tan x$ has period π.

Phase change
The phase change of a function involves moving the graph left or right in a horizontal direction.

Pythagorean identity
Using the unit circle definition of sine and cosine, it can be shown that for any angle, $\boldsymbol{\theta}$ the relationship $\mathbf{sin^2}\,\boldsymbol{\theta}+\mathbf{cos^2}\,\boldsymbol{\theta}=\mathbf{1}$ will be true.

Sine, cosine and tangent functions
Each angle θ measured anticlockwise from the positive x-axis determines a point P on the unit circle, such that

- the cosine of θ is the x-coordinate of the point P
- the sine of θ is the y-coordinate of the point P
- the tangent of θ is the gradient of the line segment OP.

Standard unit circle angles
Standard unit circle angles are angles on the unit circle for which sine and cosine ratios are exact values.

Probability

Conditional probability
The probability that an event will occur given that another event has already occurred.

Independent events
Events are independent if knowing that one event has occurred does not affect the probability of the other event occurring.

Weighted tree diagram
A visual representation that shows the probability of each possible outcome on the branches of the tree.

Introduction to differential calculus

Differentiation by first principles
A method for determining the derivative function using the limiting chord process and applying algebraic techniques to simplify the expression.

Normal to the curve
The normal to the curve at a given point is the straight line that is perpendicular to the tangent line at the point of contact with the curve.

Power function
A polynomial function of the form $f(x)=ax^n$. Every power function is a polynomial but not every polynomial is a power function.

Tangent
The tangent (or the tangent line) to a curve at a given point can be described as the straight line that 'touches' the curve at that point only and has the same gradient as the curve at this point.