

Course Overviews DP (Maths HL) , UWC Thailand 2017-2018

All units taught in grades 11 and 12 are continuously being developed and improved to best meet the needs of the students at UWCT. Therefore, the following overview is only a reflection of current plans for the course. Some changes to these course overviews may occur as a result of planning done throughout the academic year.

Grade	Time Frame	Unit number and title	Approaches To learning skills taught / learnt / developed in this unit	Content (topics / knowledge/ subject specific skills)	Connections to TOK	Summative assessment
11	2 weeks	1. Sequences and series	Thinking Skills	Syllabus: 1.1	Math as art: Beauty and proportionality - link to fibonacci	Test
11	15 weeks	2. Functions	Thinking skills Conceptual understanding Communication skills	Syllabus: Topic 2; 1.2; 1.8	Mathematics and knowledge claims. Does studying the graph of a function contain the same level of mathematical rigour as studying the function algebraically (analytically)?	Test - Quadratics Test - Functions Test - Exponentials and Logarithms Test - Transformations of functions Test - Real Polynomials and complex solutions
11	7 weeks	3. Trigonometry and Circular Functions	Thinking skills Inquiry Conceptual understanding	Syllabus: Topic 3	<p>Mathematics and the knower. Why do we use radians? (The arbitrary nature of degree measure versus radians as real numbers and the implications of using these two measures on the shape of sinusoidal graphs.)</p> <p>Mathematics and knowledge claims. If trigonometry is based on right triangles, how can we sensibly consider trigonometric ratios of angles greater than a right angle?</p>	Investigation - Nai Yang tides Quiz - Trigonometry Test - Circular functions

11	3 weeks	4. Counting, binomial expansion and proofs by induction	Thinking skills Communication skills Conceptual understanding	Syllabus: 1.3; 1.4	Nature of mathematics and science. What are the different meanings of induction in mathematics and science? The nature of mathematics. The unforeseen links between Pascal's triangle, counting methods and the coefficients of polynomials. Is there an underlying truth that can be found linking these?	Test
11	3 weeks	5. Complex numbers	Thinking skills Conceptual understanding	Syllabus: 1.5; 1.6; 1.7	Mathematics and the knower. Why might it be said that $i^{10} \pi + =$ is beautiful?	Test
11	4 weeks	6. Introduction to differential calculus and applications	Thinking skills Conceptual understanding	Syllabus: 6.1; 6.2; 6.3	The nature of mathematics. Does the fact that Leibniz and Newton came across the calculus at similar times support the argument that mathematics exists prior to its discovery? Mathematics and the real world. The seemingly abstract concept of calculus allows us to create mathematical models that permit human feats, such as getting a man on the Moon. What does this tell us about the links between mathematical models and physical reality?	End of year Exam - examined all topics for the year, including topic 6.
			Andrew Raferty Above Jon Disher Below			
11 or 12		MATH HL Topic 1- Algebra 1.1	Thinking Skills Communication skills Social skills Self-management skills Research skills	Arithmetic sequences and series; sum of finite arithmetic series; geometric sequences and series; sum of finite and infinite geometric series. Sigma notation.	Int: The chess legend (Sissa ibn Dahir). Int: Aryabhata is sometimes considered the "father of algebra".	IB Test using Question bank Made yearly

			<p>Inquiry Conceptual understanding Local and global contexts Teamwork and collaboration</p>		<p>Compare with al-Khwarizmi. Int: use of several alphabets in mathematical notation (eg first term and common difference of an arithmetic sequence). TOK: Mathematics and the knower. To what extent should mathematical knowledge be consistent with our intuition?</p>	
11 or 12		Topic 1- Algebra 1.2	<p>Thinking skills Communication skills Conceptual understanding</p>	<p>Exponents and logarithms. Laws of exponents; laws of logarithms. Change of base.</p>	<p>Appl: Chemistry 18.1, 18.2 (calculation of pH and buffer solutions). TOK: The nature of mathematics and science. Were logarithms an invention or discovery? (This topic is an opportunity for teachers and students to reflect on "the nature of mathematics".)</p>	<p>IB Test using Question bank Made yearly</p>
11 or 12		Topic 1- Algebra 1.3	<p>Thinking skills Communication skills Conceptual understanding</p>	<p>Counting principles, including permutations and combinations The binomial theorem: expansion. Not required: Permutations where some objects are identical. Circular arrangements. Proof of binomial theorem.</p>	<p>TOK: The nature of mathematics. The unforeseen links between Pascal's triangle, counting methods and the coefficients of polynomials. Is there an underlying truth that can be found linking these? Int: The properties of Pascal's triangle were known in a number of different cultures long before Pascal (eg the Chinese mathematician Yang Hui). Aim 8: How many different tickets are</p>	<p>IB Test using Question bank Made yearly</p>

					possible in a lottery? What does this tell us about the ethics of selling lottery tickets to those who do not understand the implications of these large numbers?	
11 or 12		Topic 1- Algebra 1.4	Thinking skills Communication skills Conceptual understanding	Proof by mathematical induction.	TOK: Nature of mathematics and science. What are the different meanings of induction in mathematics and science? TOK: Knowledge claims in mathematics. Do proofs provide us with completely certain knowledge? TOK: Knowledge communities. Who judges the validity of a proof?	IB Test using Question bank Made yearly
11 or 12		Topic 1- Algebra 1.5	Thinking skills Communication skills Conceptual understanding	Complex numbers ; the terms real part, imaginary part, conjugate, modulus and argument. Cartesian form $z = a + ib$. Sums, products and quotients of complex numbers.	Appl: Concepts in electrical engineering. Impedance as a combination of resistance and reactance; also apparent power as a combination of real and reactive powers. TOK: Mathematics and the knower. Do the words imaginary and complex make the concepts more difficult than if they had different names? TOK: The nature of mathematics. Has "i" been invented or was it discovered? TOK: Mathematics and the world. Why does "i" appear in so many fundamental laws of physics?	IB Test using Question bank Made yearly

11 or 12		Topic 1- Algebra 1.6	Thinking skills Communication skills Conceptual understanding	Modulus–argument (polar) form The complex plane.	Appl: Concepts in electrical engineering. Phase angle/shift, power factor and apparent power as a complex quantity in polar form. TOK: The nature of mathematics. Was the complex plane already there before it was used to represent complex numbers geometrically?	IB Test using Question bank Made yearly
11 or 12		Topic 1- Algebra 1.7	Thinking skills Communication skills Conceptual understanding	Powers of complex numbers: de Moivre's theorem. nth roots of a complex number.	TOK: Reason and mathematics. What is mathematical reasoning and what role does proof play in this form of reasoning? Are there examples of proof that are not mathematical?	IB Test using Question bank Made yearly
11 or 12		Topic 1- Algebra 1.8	Thinking skills Communication skills Conceptual understanding	Conjugate roots of polynomial equations with real coefficients.		IB Test using Question bank Made yearly
11 or 12		Topic 1- Algebra 1.9	Thinking skills Communication skills Conceptual understanding	Solutions of systems of linear equations (a maximum of three equations in three unknowns), including cases where there is a unique solution, an infinity of solutions or no solution.	TOK: Mathematics, sense, perception and reason. If we can find solutions in higher dimensions, can we reason that these spaces exist beyond our sense perception?	IB Test using Question bank Made yearly
		Topic 2 Functions and Equations 2.1	Thinking skills Communication skills Conceptual understanding	Concept of function $f : x \mapsto f(x)$: domain, range; image (value). Odd and even functions. Composite functions $f \circ g$. Identity function.	Int: The notation for functions was developed by a number of different mathematicians in the 17th and 18th centuries. How did the notation	IB Test using Question bank Made yearly

				One-to-one and many-to-one functions. Inverse function , including domain restriction. Self-inverse functions.	we use today become internationally accepted? TOK: The nature of mathematics. Is mathematics simply the manipulation of symbols under a set of formal rules?	
11 or 12		Functions and Equations 2.2	Thinking skills Communication skills Conceptual understanding	Investigation of key features of graphs, such as maximum and minimum values, intercepts, horizontal and vertical asymptotes and symmetry, and consideration of domain and range.	TOK: Mathematics and knowledge claims. Does studying the graph of a function contain the same level of mathematical rigour as studying the function algebraically (analytically)? Appl: Sketching and interpreting graphs; Geography SL/HL (geographic skills); Chemistry 11.3.1. Int: Bourbaki group analytical approach versus Mandelbrot visual approach.	IB Test using Question bank Made yearly
11 or 12		Functions and Equations 2.3	Thinking skills Communication skills Conceptual understanding	stretches; reflections in the axes. The graph of the inverse function as a reflection in $y = x$.	Appl: Economics SL/HL 1.1 (shift in demand and supply curves).	IB Test using Question bank Made yearly
11 or 12		Functions and Equations 2.4	Thinking skills Communication skills Conceptual understanding	The rational function AND ITS GRAPH	Appl: Geography SL/HL (geographic skills); Physics SL/HL 7.2 (radioactive decay); Chemistry SL/HL 16.3 (activation energy); Economics SL/HL 3.2 (exchange rates).	IB Test using Question bank Made yearly
11 or 12		Functions and Equations 2.5	Thinking skills Communication skills Conceptual understanding	Polynomial functions and their graphs. The factor and remainder theorems. The fundamental theorem of algebra.		IB Test using Question bank Made yearly

11 or 12		Functions and Equations 2.6	Thinking skills Communication skills Conceptual understanding	Solving quadratic equations using the quadratic formula. Use of the discriminant to determine the nature of the roots. Solving polynomial equations both graphically and algebraically. Sum and product of the roots of polynomial equations.	Appl: Chemistry 17.2 (equilibrium law). Appl: Physics 2.1 (kinematics). Appl: Physics 4.2 (energy changes in simple harmonic motion). Appl: Physics (HL only) 9.1 (projectile motion). Aim 8: The phrase "exponential growth" is used popularly to describe a number of phenomena. Is this a misleading use of a mathematical term?	IB Test using Question bank Made yearly
11 or 12		Functions and Equations 2.7	Thinking skills Communication skills Conceptual understanding	Solutions of $g(x) \square f(x)$. Graphical or algebraic methods, for simple polynomials up to degree 3. Use of technology for these and other functions.		IB Test using Question bank Made yearly
11 or 12		Topic 3 Circular Functions and Trigonometry 3.1	Thinking skills Communication skills Conceptual understanding	The circle: radian measure of angles. Length of an arc; area of a sector.	I	IB Test using Question bank Made yearly
11 or 12		Topic 3 Circular Functions and Trigonometry 3.2	Thinking skills Communication skills Conceptual understanding	Definition of $\cos \square$, $\sin \square$ and $\tan \square$ in terms of the unit circle. Exact values of \sin , \cos and \tan and their multiples. Definition of the reciprocal trigonometric ratios . Pythagorean identities:	Int: The origin of degrees in the mathematics of Mesopotamia and why we use minutes and seconds for time. TOK: Mathematics and the knower. Why do we use radians? (The arbitrary nature of degree measure versus radians as real numbers and the implications of using these two measures on the shape of sinusoidal graphs.) TOK: Mathematics and knowledge claims. If trigonometry is based on right triangles, how can we sensibly consider	IB Test using Question bank Made yearly

					<p>trigonometric ratios of angles greater than a right angle? Int: The origin of the word "sine". Appl: Physics SL/HL 2.2 (forces and dynamics). Appl: Triangulation used in the Global Positioning System (GPS). Int: Why did Pythagoras link the study of music and mathematics? Appl: Concepts in electrical engineering. Generation of sinusoidal voltage.</p>	
11 or 12		Topic 3 Circular Functions and Trigonometry 3.3	Thinking skills Communication skills Conceptual understanding	Compound angle identities. Double angle identities. Not required: Proof of compound angle identities.		IB Test using Question bank Made yearly
11 or 12		Topic 3 Circular Functions and Trigonometry 3.4	Thinking skills Communication skills Conceptual understanding	Composite functions of the form $f(x) = a \sin(b(x - c)) + d$.	TOK: Mathematics and the world. Music can be expressed using mathematics. Does this mean that music is mathematical, that mathematics is musical or that both are reflections of a common "truth"? Appl: Physics SL/HL 4.1 (kinematics of simple harmonic motion).	IB Test using Question bank Made yearly
11 or 12		Topic 3 Circular Functions and Trigonometry 3.5	Thinking skills Communication skills Conceptual understanding	The inverse functions their domains and ranges; their graphs.		IB Test using Question bank Made yearly
11 or 12		Topic 3 Circular Functions and Trigonometry 3.6	Thinking skills Communication skills Conceptual understanding	Algebraic and graphical methods of solving trigonometric equations in a finite interval, including the use of trigonometric identities and factorization.		IB Test using Question bank Made yearly

				Not required: The general solution of trigonometric equations.		
11 or 12		Topic 3 Circular Functions and Trigonometry 3.7	Thinking skills Communication skills Conceptual understanding	The cosine rule The sine rule including the ambiguous case. Area of a triangle	TOK: Nature of mathematics. If the angles of a triangle can add up to less than 180° , 180° or more than 180° , what does this tell us about the "fact" of the angle sum of a triangle and about the nature of mathematical knowledge?	IB Test using Question bank Made yearly
11 or 12		Topic 4 Vectors 4.1	Thinking skills Communication skills Conceptual understanding	Concept of a vector. Representation of vectors using directed line segments. Unit vectors; base vectors i, j, k . Components of a vector: Algebraic and geometric approaches to the following: the sum and difference of two vectors; the zero vector 0 , the vector v ; multiplication by a scalar, kv ; magnitude of a vector, v ; position vectors OA	Aim 8: Vectors are used to solve many problems in position location. This can be used to save a lost sailor or destroy a building with a laser-guided bomb. Components of a vector: Appl: Physics SL/HL 1.3 (vectors and scalars); Physics SL/HL 2.2 (forces and dynamics). TOK: Mathematics and knowledge claims. You can perform some proofs using different mathematical concepts. What does this tell us about mathematical knowledge?	IB Test using Question bank Made yearly
11 or 12		Topic 4 Vectors 4.2	Thinking skills Communication skills Conceptual understanding	The definition of the scalar product of two vectors. Properties of the scalar product: The angle between two vectors. Perpendicular vectors; parallel vectors.	Appl: Physics SL/HL 2.2 (forces and dynamics). TOK: The nature of mathematics. Why this definition of scalar product?	IB Test using Question bank Made yearly

11 or 12		Topic 4 Vectors 4.3	Thinking skills Communication skills Conceptual understanding	Vector equation of a line in two and three dimensions: $r = a + \lambda b$. Simple applications to kinematics. The angle between two lines.	Appl: Modelling linear motion in three dimensions. Appl: Navigational devices, eg GPS. TOK: The nature of mathematics. Why might it be argued that vector representation of lines is superior to Cartesian?	IB Test using Question bank Made yearly
11 or 12		Topic 4 Vectors 4.4	Thinking skills Communication skills Conceptual understanding	Coincident, parallel, intersecting and skew lines; distinguishing between these cases. Points of intersection.		IB Test using Question bank Made yearly
11 or 12		Topic 4 Vectors 4.5	Thinking skills Communication skills Conceptual understanding	The definition of the vector product of two vectors. Properties of the vector product:		IB Test using Question bank Made yearly
11 or 12		Topic 4 Vectors 4.6	Thinking skills Communication skills Conceptual understanding	Vector equation of a plane . Use of normal vector to obtain the form Cartesian equation of a plane		IB Test using Question bank Made yearly
11 or 12		Topic 4 Vectors 4.7	Thinking skills Communication skills Conceptual understanding	Intersections of: a line with a plane; two planes; three planes. Angle between: a line and a plane; two planes.		IB Test using Question bank Made yearly
11 or 12		Topic 5 Statistics and Probability 5.1	Thinking skills Communication skills Conceptual understanding	Concepts of population, sample, random sample and frequency distribution of discrete and continuous data. Grouped data: mid-interval values, interval width, upper and lower interval boundaries. Mean, variance, standard deviation. Not required: Estimation of mean and variance of a population from a sample.	TOK: The nature of mathematics. Why have mathematics and statistics sometimes been treated as separate subjects? TOK: The nature of knowing. Is there a difference between information and data? Aim 8: Does the use of statistics lead to an overemphasis on attributes	IB Test using Question bank Made yearly

					<p>that can easily be measured over those that cannot?</p> <p>Appl: Psychology SL/HL (descriptive statistics); Geography SL/HL (geographic skills); Biology SL/HL 1.1.2 (statistical analysis).</p> <p>Appl: Methods of collecting data in real life (census versus sampling).</p> <p>Appl: Misleading statistics in media reports.</p>	
11 or 12		Topic 5 Statistics and Probability 5.2	<p>Thinking skills</p> <p>Communication skills</p> <p>Conceptual understanding</p>	<p>Concepts of trial, outcome, equally likely outcomes, sample space (U) and event.</p> <p>The probability of an event A</p> <p>The complementary events A and \bar{A} (not A).</p> <p>Use of Venn diagrams, tree diagrams, counting principles and tables of outcomes to solve problems.</p>		<p>IB Test using Question bank</p> <p>Made yearly</p>
11 or 12		Topic 5 Statistics and Probability 5.3	<p>Thinking skills</p> <p>Communication skills</p> <p>Conceptual understanding</p>	<p>Combined events; the formula for $P(A \cup B)$.</p> <p>Mutually exclusive events.</p>		<p>IB Test using Question bank</p> <p>Made yearly</p>
11 or 12		Topic 5 Statistics and Probability 5.4	<p>Thinking skills</p> <p>Communication skills</p> <p>Conceptual understanding</p>	<p>Conditional probability;</p> <p>Independent events; the definition</p> <p>Use of Bayes' theorem for a maximum of three events.</p>	<p>Appl: Use of probability methods in medical studies to assess risk factors for certain diseases.</p> <p>TOK: Mathematics and knowledge claims. Is independence as defined in probabilistic terms the same as that found in normal experience?</p>	<p>IB Test using Question bank</p> <p>Made yearly</p>
11 or 12		Topic 5 Statistics and Probability 5.5	<p>Thinking skills</p> <p>Communication skills</p> <p>Conceptual understanding</p>	<p>Concept of discrete and continuous random variables and their probability distributions.</p> <p>Definition and use of probability density functions.</p> <p>TOK: Mathematics and the knower. To what</p>	<p>TOK: Mathematics and the knower. To what extent can we trust samples of data?</p>	<p>IB Test using Question bank</p> <p>Made yearly</p>

				extent can we trust samples of data? Expected value (mean), mode, median, variance and standard deviation.		
11 or 12		Topic 5 Statistics and Probability 5.6	Thinking skills Communication skills Conceptual understanding	Binomial distribution, its mean and variance. Poisson distribution, its mean and variance.		IB Test using Question bank Made yearly
11 or 12		Topic 5 Statistics and Probability 5.7	Thinking skills Communication skills Conceptual understanding	Normal distribution.		IB Test using Question bank Made yearly
11 or 12		Topic 6 Calculus 6.1	Thinking skills Communication skills Conceptual understanding	Informal ideas of limit, continuity and convergence. Definition of derivative from first principles The derivative interpreted as a gradient function and as a rate of change. Finding equations of tangents and normals. Identifying increasing and decreasing functions.	TOK: The nature of mathematics. Does the fact that Leibniz and Newton came across the calculus at similar times support the argument that mathematics exists prior to its discovery? Int: How the Greeks' distrust of zero meant that Archimedes' work did not lead to calculus. Int: Investigate attempts by Indian mathematicians (500–1000 CE) to explain division by zero. TOK: Mathematics and the knower. What does the dispute between Newton and Leibniz tell us about human emotion and mathematical discovery? Appl: Economics HL 1.5 (theory of the firm); Chemistry SL/HL 11.3.4 (graphical techniques); Physics SL/HL 2.1 (kinematics).	IB Test using Question bank Made yearly
11 or 12		Topic 6 Calculus 6.2	Thinking skills	Derivatives of $\sin x$, $\cos x$, $\tan x$, e^x and		IB Test using

			<p>Communication skills Conceptual understanding</p>	<p>$\ln x$. Differentiation of sums and multiples of functions. The product and quotient rules. The chain rule for composite functions. Related rates of change. Implicit differentiation. Derivatives of $\sec x$, $\csc x$, $\cot x$, ax , $\log_a x$, $\arcsin x$, $\arccos x$ and $\arctan x$.</p>		<p>Question bank Made yearly</p>
11 or 12		Topic 6 Calculus 6.3	<p>Thinking skills Communication skills Conceptual understanding</p>	<p>Local maximum and minimum values. Optimization problems. Points of inflexion with zero and non-zero gradients. Graphical behaviour of functions, including the relationship between the graphs</p>		<p>IB Test using Question bank Made yearly</p>
11 or 12		Topic 6 Calculus 6.4	<p>Thinking skills Communication skills Conceptual understanding</p>	<p>Indefinite integration as anti-differentiation. Indefinite integral of x^n , $\sin x$, $\cos x$ and e^x . Other indefinite integrals using the results from 6.2. The composites of any of these with a linear function.</p>		<p>IB Test using Question bank Made yearly</p>
11 or 12		Topic 6 Calculus 6.5	<p>Thinking skills Communication skills Conceptual understanding</p>	<p>Anti-differentiation with a boundary condition to determine the constant of integration. Definite integrals. Area of the region enclosed by a curve and the x-axis or y-axis in a given interval; areas of regions enclosed by curves Volumes of revolution about the x-axis or y-axis</p>		<p>IB Test using Question bank Made yearly</p>
11 or 12		Topic 6 Calculus 6.6	<p>Thinking skills Communication skills Conceptual understanding</p>	<p>Kinematic problems involving displacement s, velocity v and acceleration a. Total distance travelled.</p>		<p>IB Test using Question bank Made yearly</p>
11 or 12		Topic 6 Calculus 6.7	<p>Thinking skills Communication skills Conceptual understanding</p>	<p>Integration by substitution Integration by parts.</p>		<p>IB Test using Question bank Made yearly</p>

