COURSE OUTLINE – DP MATHEMATICS ANALYSIS & APPROACHES SL & HL

Course Description:

IB Mathematics Analysis and Approaches contains a broad range of mathematical concepts and caters to students who anticipate a need for a sound mathematical background in preparation for future studies in subjects that have significant mathematical content, such as science related fields, mathematics related fields, engineering and business administration. The nature of the subject is such that the curriculum focuses on the introduction of important mathematical concepts through the development of mathematical techniques. The majority of concepts are included because they underpin important mathematical processes. In many cases, concepts are included because they are essential to any further study in mathematics. Students taking this course are expected to possess a ready knowledge of basic concepts and to be equipped with the skills needed to apply mathematical techniques correctly. Students who choose the HL option in mathematics will delve deeper into complex mathematical concept and skills in all five big topics.

HL Option:

The HL option in Mathematics Analysis and Approaches focuses on developing important mathematical concepts in a comprehensible, coherent and rigorous way. Students are encouraged to apply their mathematical knowledge to solve problems set in a variety of meaning contexts. Development of each topic should feature justification and proof of results. Students embarking on this course should expect to develop insight into mathematical form and structure, and should be intellectually equipped to appreciate the links between concepts in different topic areas. The HL course is a demanding one, requiring students to study a broad range of mathematical topics through a number of different approaches and to varying degrees of depth.

IB Concepts and Considerations

- **THEORY OF KNOWLEDGE (TOK):** Students will reflect on the nature of knowledge in Math, and on how we know what we claim to know throughout the course.

- **CREATIVITY, ACTIVITY, SERVICE (CAS):** Students will be encouraged to consider ways they can take meaningful action in their CAS activities connected to topics learned in Math throughout the course.

- **APPROACHES TO LEARNING (ATL): Thinking, Social, Communication, Research**, and **Self-Management** skills will be developed and encouraged throughout the course.

- **LEARNER PROFILE ATTRIBUTES (LP):** Connections will be made to the IB Learner Profile Attributes (**Inquirer, Knowledgeable, Thinker, Communicator, Principled, Open-minded, Caring, Risk-taker, Balanced,** and **Reflective)** throughout the course. Students are encouraged to embody these traits as IB learners.

Course Syllabus Component :

Syllabus component	Suggested teaching hours	
	SL	HL
Topic 1—Number and algebra	19	39
Topic 2—Functions	21	32
Topic 3— Geometry and trigonometry	25	51
Topic 4—Statistics and probability	27	33
Topic 5 —Calculus	28	55
The toolkit and the mathematical exploration Investigative, problem-solving and modelling skills development leading to an individual exploration. The exploration is a piece of written work that involves investigating an area of mathematics.	30	30
Total teaching hours	**150**	**240**

All topics are compulsory. Students must study all the sub-topics in each of the topics in the syllabus as listed in this guide. Students are also required to be familiar with the topics listed as prior learning.

Assessment Objectives:

Problem-solving is central to learning mathematics and involves the acquisition of mathematical skills and concepts in a wide range of situations, including non-routine, open-ended and real-world problems. Having followed a DP mathematics course, students will be expected to demonstrate the following.

1. **Knowledge and understanding**: recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of familiar and unfamiliar contexts.
2. **Problem-solving**: recall, select and use their knowledge of mathematical skills, results and models in both real and abstract contexts to solve problems.
3. **Communication and interpretation**: transform common realistic contexts into mathematics; comment on the context; sketch or draw mathematical diagrams, graphs or constructions both on paper and using technology; record methods, solutions and conclusions using standardized notation.
4. **Technology**: use technology, accurately, appropriately and efficiently both to explore new ideas and to solve problems.
5. **Reasoning**: construct mathematical arguments through use of precise statements, logical deduction and inference, and by the manipulation of mathematical expressions.
6. **Inquiry approaches**: investigate unfamiliar situations, both abstract and real-world, involving organizing and analysing information, making conjectures, drawing conclusions and testing their validity.

Assessment Overview & Timeline:

The course will be geared towards preparing the students for the IB exams that take place at the end of the second year. There will be some cumulative evaluation (unit tests, etc) which will give both the student and the teacher a snapshot of the student's progress in terms of their understanding of the curriculum, but will not affect their Math SL/HL IB final mark. The final mark that will count towards graduation comes from a combination of external and internal assessment specified by the International Baccalaureate Organization.

SL Assessment Component:
First Assessment 2021

Assessment component	Weighting
External assessment (3 hours)	80%
Paper 1 (90 minutes)	
No technology allowed. (80 marks)	40%
Section A	
Compulsory short-response questions based on the syllabus.	
Section B	
Compulsory extended-response questions based on the syllabus.	
Paper 2 (90 minutes)	40%
Technology required. (80 marks)	
Section A	
Compulsory short-response questions based on the syllabus.	
Section B	
Compulsory extended-response questions based on the syllabus	
Internal assessment	20%
This component is internally assessed by the teacher and externally moderated by the IB at the end of the course.	
Mathematical exploration	
Internal assessment in mathematics is an individual exploration. This is a piece of written work that involves investigating an area of mathematics. (20 marks)	

HL Assessment Component:
First Assessment 2021

Assessment component	Weighting
External assessment (5 hours)	80%
Paper 1 (120 minutes)	
No technology allowed. (110 marks)	30%
Section A	
Compulsory short-response questions based on the syllabus.	
Section B	
Compulsory extended-response questions based on the syllabus.	
Paper 2 (120 minutes)	30%
Technology required. (110 marks)	
Section A	
Compulsory short-response questions based on the syllabus.	
Section B	
Compulsory extended-response questions based on the syllabus.	
Paper 3 (60 minutes)	20%
Technology required. (55 marks)	
Two compulsory extended response problem-solving questions.	
Internal assessment	20%
This component is internally assessed by the teacher and externally moderated by the IB at the end of the course.	
Mathematical exploration	
Internal assessment in mathematics is an individual exploration. This is a piece of written work that involves investigating an area of mathematics. (20 marks)	

Internal Assessment Criteria
The exploration is internally assessed by the teacher and externally moderated by the IB using assessment criteria that relate to the objectives for mathematics SL/HL. Each exploration is assessed against the following five criteria. The final mark for each exploration is the sum of the scores for each criterion. The maximum possible final mark is 20.
Students will not receive a grade for mathematics SL/HL if they have not submitted an exploration.

Criterion A	Communication
Criterion B	Mathematical presentation
Criterion C	Personal engagement
Criterion D	Reflection
Criterion E	Use of mathematics

Grade Descriptors in DP Math Assessment:

Grade 7

Demonstrates a thorough knowledge and comprehensive understanding of the syllabus; successfully constructs and applies mathematical arguments at a sophisticated level in a wide variety of contexts; successfully uses problem-solving techniques in challenging situations; recognizes patterns and structures, makes generalizations and justifies conclusions; understands and explains the significance and validity of results, and draws full and relevant conclusions; communicates mathematics in a clear, effective and concise manner, using correct techniques, notation and terminology; demonstrates the ability to integrate knowledge, understanding and skills from different areas of the course; uses technology correctly in challenging situations— makes efficient use of calculator's functionality when required.

Grade 6

Demonstrates a broad knowledge and comprehensive understanding of the syllabus; successfully constructs and applies mathematical arguments in a variety of contexts; uses problem-solving techniques in challenging situations; recognizes patterns and structures, and makes some generalizations; understands and explains the significance and validity of results, and draws relevant conclusions; communicates mathematics in a clear and effective manner, using correct techniques, notation and terminology; demonstrates some ability to integrate knowledge, understanding and skills from different areas of the course; uses technology correctly in routine situations—makes efficient use of calculator's functionality when required.

Grade 5

Demonstrates a broad knowledge and good understanding of the syllabus; applies mathematical arguments in performing routine tasks; successfully uses problem-solving techniques in routine situations; successfully carries out mathematical processes in a variety of contexts, and recognizes patterns and structures; understands the significance of results and draws some conclusions; communicates mathematics effectively, using appropriate techniques, notation and terminology; demonstrates an awareness of the links between different areas of the course; makes use of calculator's functionality when required—may occasionally be inefficient.

Grade 4

Demonstrates a satisfactory knowledge of the syllabus; applies mathematical arguments in performing some routine tasks; uses problem-solving techniques in routine situations; successfully carries out mathematical processes in straightforward contexts; shows some ability to recognize patterns and structures; has limited understanding of the significance of results and attempts to draw some conclusions; communicates mathematics adequately, using some appropriate techniques, notation and terminology; makes some use of calculator's functionality, but perhaps not always when required—may be inefficient at times.

Grade 3

Demonstrates partial knowledge of the syllabus and limited understanding of mathematical arguments in performing some routine tasks; attempts to carry out mathematical processes in straightforward contexts; makes an attempt to use problem-solving techniques in routine situations; communicates some mathematics, using some appropriate techniques, notation or terminology; occasionally uses calculator's functionality, but often inefficiently; does not always use it when required and may use an inefficient analytic approach.

Grade 2

Demonstrates limited knowledge of the syllabus; attempts to carry out mathematical processes at a basic level; communicates some mathematics, but often uses inappropriate techniques, notation or terminology; unable to use calculator correctly when required—questions exclusively requiring the use of the GDC are generally not attempted.

Grade 1

Demonstrates minimal knowledge of the syllabus; demonstrates little or no ability to use mathematical processes, even when attempting routine tasks; communicates only minimal mathematics and consistently uses inappropriate techniques, notation or terminology; is unable to make effective use of technology.

BC Ministry Requirements:

In line with the philosophy of the IB Diploma Programme, students will be assessed against the course objectives at their current level of achievement on the 7-point scale throughout the course. As required by the Ministry of Education, students will also be given a percentage converted from the IB level that reflects their achievement in relation to the corresponding BC Curriculum course.

Academic Honesty and Personal Integrity

The faculty at Carson Graham expects our students to complete academic and nonacademic work that is authentic and respectful of intellectual property. As diploma candidates, you are expected to adhere to the school's Policy for Academic Integrity, and also to the principles and practices set out in the IB document, Diploma Programme: Academic Honesty, 2011. Ignorance of the standards related to academic honesty and student integrity is not an excuse for dishonesty, plagiarism and malpractice. You are expected to familiarize yourself with the policy.

In accordance with this policy, students can use advanced automated tools (artificial intelligence or machine learning tools such as ChatGPT or Dall-E 2) on assignments in this course if instructor permission is obtained in advance. Unless permission is given to use the aforementioned tools, each student is expected to complete each assignment without substantive assistance from others, including automated tools.

http://www.sd44.ca/school/carson/Documents/Carson%20Graham%20Policy%20for%20Academic%20Honesty%20June%202015.pdf

Prior Learning Topics:

Number and algebra

- Number systems: natural numbers $\mathbb{N}$; integers, $\mathbb{Z}$; rationals, $\mathbb{Q}$, and irrationals; real numbers, $\mathbb{R}$
- SI (Système International) units for mass, time, length and their derived units, eg. speed, area and volume
- Rounding, decimal approximations and significant figures, including appreciation of errors
- Definition and elementary treatment of absolute value (modulus), $|a|$
- Use of addition, subtraction, multiplication and division using integers, decimals and fractions, including order of operations
- Prime numbers, factors (divisors) and multiples
- Greatest common factor (divisor) and least common multiples (HL only)
- Simple applications of ratio, percentage and proportion
- Manipulation of algebraic expressions, including factorization and expansion
- Rearranging formulae
- Calculating the numerical value of expressions by substitution
- Evaluating exponential expressions with simple positive exponents
- Evaluating exponential expressions with rational exponents (HL only)
- Use of inequalities, $<$, $\leq$, $>$, $\geq$, intervals on the real number line
- Simplification of simple expressions involving roots (surds or radicals)
- Rationalising the denominator (HL only)
- Expression of numbers in the form $a \times 10^k$, $1 \leq a < 10$, $k \in \mathbb{Z}$
- Familiarity with commonly accepted world currencies
- Solution of linear equations and inequalities

- Solution of quadratic equations and inequalities with rational coefficients (HL only)
- Solving systems of linear equations in two variables
- Concept and basic notation of sets. Operations on sets: union and intersection
- Addition and subtraction of algebraic fractions (HL only).

Functions

- Graphing linear and quadratic functions using technology
- Mappings of the elements of one set to another. Illustration by means of sets of ordered pairs, tables, diagrams and graphs.

Geometry and trigonometry

- Pythagoras' theorem and its converse
- Mid-point of a line segment and the distance between two points in the Cartesian plane
- Geometric concepts: point, line, plane, angle
- Angle measurement in degrees, compass directions
- The triangle sum theorem
- Right-angle trigonometry, including simple applications for solving triangles
- Three-figure bearings
- Simple geometric transformations: translation, reflection, rotation, enlargement
- The circle, its centre and radius, area and circumference. The terms diameter, arc, sector, chord, tangent and segment
- Perimeter and area of plane figures. Properties of triangles and quadrilaterals, including parallelograms, rhombuses, rectangles, squares, kites and trapezoids; compound shapes
- Familiarity with three-dimensional shapes (prisms, pyramids, spheres, cylinders and cones)
- Volumes and surface areas of cuboids, prisms, cylinders, and compound three-dimensional shapes

Statistics and probability

- The collection of data and its representation in bar charts, pie charts, pictograms, and line graphs
- Obtaining simple statistics from discrete data, including mean, median, mode, range
- Calculating probabilities of simple events
- Venn diagrams for sorting data
- Tree diagrams

Calculus

$$\text{Speed} \quad = \quad \frac{\text{distance}}{\text{time}}$$