Comprehensive Course Syllabus

AB Calculus 1

Course Description:

AB Calculus I is the first of a two-semester sequence designed to give a solid introduction to the study of Calculus. Students must have successfully completed MI-4, or its equivalent. The semester includes an intuitive approach to the rate of change of a function, limits, the definition of the derivative, and techniques for finding derivatives of various functions. Throughout the semester, students will also study a variety of applications of the derivative including many properties of functions, max/min problems, growth, and differential equations.

Instructor:

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Availability:

Often Mods 3-4, 7. Also by appointment.

Text / Materials:

Briggs, William, et. al., *Calculus, AP Edition*. Boston: Pearson Education, Inc., 2014.

There is also an online suite of materials – *MathLX for School* – that comes with the text, and we might utilize that as well.

Essential Content:

Understanding Derivatives
- Slope of a tangent line
- Methods of approximation, including notion of step size
- $\Delta y = f'(x) \cdot \Delta x$
- Average vs. instantaneous rate of change
- Geometry of derivatives, including f' and f''
- Graphically constructing derivatives and antiderivatives

- Interpretations in context

Defining the Derivative and theory
- Limits –
  - Intuitive understanding of a limit
  - Computation of basic limits
- Continuity of a function
- Definition of the derivative as a limit

Computations of derivatives
- Rules for differentiating elementary functions
- Product, quotient, and chain rules
- Implicit differentiation

Applications of the derivative
- Position, velocity, acceleration
- Optimization

Differential Equations
- Introduction to modeling quantities that change with time
- General and particular solutions

IMSA Math Standards addressed:

A. Students studying mathematics at IMSA demonstrate a disposition and propensity to use mathematics, a variety of problem solving strategies, and creative thought to solve problems by:

A.1	investigating and gaining insight into mathematical concepts by selecting and using a variety of traditional and creative problem solving strategies and methodologies. [SSL-I.B,III.B,III.C,IV.A]
A.3	interpreting, generalizing , and verifying the understanding gained in the problem solving process and extending it to new settings. [SSL-I.B,II.B,III.B,III.C,IV.A,IV.C;]
A.5	demonstrating confidence, persistence, and reflective analysis of the effectiveness of an approach when attempting to solve a problem. [SSL-I.D,II.A,II.B,III.B,IV.A,IV.C]

B. Students studying mathematics at IMSA reason logically in mathematical situations and understand the nature, role, and necessity of proof and counterexample in mathematical reasoning by:

B.2	reasoning inductively and deductively. [SSL-I.B,III.C,IV.A]
B.3	making and testing conjectures, creating proofs, and identifying counterexamples. [SSL-III.C,IV.B]

B.4 enhancing inductive and deductive reasoning through the use of intuition, imagination, and other forms of reasoning. [SSL-III.C,IV.A]

B.5 analyzing and critiquing proofs created by themselves and others. [SSL-I.D,II.B,III.C,IV.A,IV.B,V.A]

B.6 understanding the role of logic in the development of mathematics and understanding the necessity of carefully proving assertions. [SSL-II.A,II.B,III.C,IV.D]

C. Students studying mathematics at IMSA communicate clearly and accurately about mathematical relationships and results by:

C.1 understanding mathematical information given in written, oral, symbolic, numeric, or graphic form and interpreting the relationship it represents. [SSL-IV.B]

C.2 accurately recording and effectively communicating using proper notation, vocabulary, and usage in a variety of modalities (written, oral, graphic, algebraic, etc.). [SSL-I.C,IV.B,V.A]

C.3 presenting mathematical work and results using the power of mathematical language effectively. [SSL-IV.B,V.A; IL-AoL-2,7.C; NCTM-8.2,8.4]

C.4 summarizing results in a form that is accurate, appropriate to the topic and level, and understandable to the intended audience. [SSL-I.C,IV.B,V.A]

D. Students studying mathematics at IMSA demonstrate awareness of the inter-connectedness of mathematical thought in inter- and intra-disciplinary settings by:

D.1 understanding that mathematics is a system of interconnected ideas. [SSL-III.B,III.C,IV.]

D.2 recognizing the commonalties among the components and processes of the sub-disciplines of mathematics. [SSL-I.B,III.B,III.C,IV.C]

E. Students studying mathematics at IMSA understand and employ the power, economy, clarity, and elegance of mathematical representations by:

E.1 recognizing that mathematical representations carry specific meanings and using mathematical notation correctly to enhance clarity and avoid ambiguity. [SSL-II.B,IV.B]

E.2 applying a variety of techniques to compare and manipulate mathematical representations. [SSL-I.A,III.B,IV.C]

E.3 recognizing the structure underlying a mathematical representation and utilizing this structure in analysis and problem solving. [SSL-III.B,IV.A,IV.C]

E.4 selecting an appropriate mathematical representation and demonstrating how it reflects the salient points of the situation it describes. [SSL-I.B,I.D,II.B,III.B,IV.A,IV.C]

H. Students studying mathematics at IMSA understand and apply the concepts of change and invariance under change by:

H.1	identifying, describing, and measuring various patterns of change. [SSL-I.C,IV.A,IV.B; IL-6.D,8.A]
H.2	applying limiting processes in graphical, numerical, and symbolic situations. [SSL-I.A,III.B]
H.3	applying concepts of change to problem situations using approximate or analytic methods as appropriate. [SSL-I.B,I.D,III.B]

I. Students studying mathematics at IMSA understand and apply geometric relationships by:

I.3	selecting and using appropriate geometric relationships, properties, formulas, tools, and units when working in a geometric context. [SSL-II.A,III.B,IV.A,IV.C; IL-7.A,9.A; NCTM-3.3,4.1,4.2]
I.6	solving problems involving coordinate (analytic) geometry. [SSL-I.A; IL-9.A,9.C; NCTM-3.2]

L. Students studying mathematics at IMSA use technology to gain insight and obtain different perspectives on problems by:

L.1	deciding whether to use technology, selecting an appropriate technology for a given situation, and understanding the limitation of the technology. [SSL-I.D,II.A,III.A]
L.2	using technology to facilitate doing, exploring, and understanding of mathematics. [SSL-II.A,III.A,IV.A]
L.3	judging the reasonableness of information and answers given by technology. [SSL-III.A,IV.A]

SSLs and Outcomes:

FA: Formally assessed, IA: Informally assessed

IA. Students are expected to demonstrate automaticity in skills, concepts, and processes that enable complex thought by

- completing daily homework assignments **FA, IA**
- completing regular assignments **FA**
- engaging in daily collaboration to complete or check work **IA**
- completing quizzes and tests **FA**

IB. Students are expected to construct questions, forge connections and deepen meaning by

- completing daily homework assignments **FA, IA**
- completing regular assignments **FA**
- engaging in daily collaboration to complete or check work **IA**
- completing quizzes and tests **FA**

IC. Students are expected to precisely observe phenomena and accurately record findings by

- regularly justifying conclusions and claims in all written work **FA**
- carefully supporting answers verbally with appropriate mathematical justification during in-class discussions **IA**
- engaging in daily collaboration to complete or check work **IA**

ID. Students are expected to evaluate the soundness and relevance of information and reasoning findings by

- regularly justifying conclusions and claims in all written work **FA**
- carefully supporting answers verbally with appropriate mathematical justification during in-class discussions **IA**
- engaging in daily collaboration to complete or check work **IA**

IIA. Students identify unexamined cultural, historical and personal assumptions and misconceptions that impede and skew inquiry by

- identifying weaknesses or misconceptions in related prior mathematical concepts **IA**
- discussing problems from multiple perspectives and opposing views to determine validity to various approaches **IA**
- engaging in daily collaboration to complete or check work **IA**

IIIA. Students use appropriate technologies as extensions of the mind by

- exploring mathematical ideas and problem solving using tools such as graphing calculators, Winplot, Mathematica, Excel, etc. **IA**
- making mathematical conjectures based on graphics and animations **IA**
- using web-based resources to clarify, verify, or explore ideas **IA**

IIIB. Students recognize, pursue, and explain substantive connections within and among areas of knowledge by

- applying calculus methods to familiar contexts, such as position, velocity and acceleration, and justifying conclusions **FA**
- solving problems that require similar means which involve new or less familiar application contexts and justifying conclusions **FA**

IVA. Students construct and support judgments based on evidence through

- constructing graphs of a function based on the graph of its rate of change, and vice versa, giving full written and/or verbal justification **FA**
- solving optimization problems, with full justification **FA**
- exploring and justifying solutions to differential equations **FA**

IVB. Students will be challenged to write and speak with economy, power, and elegance by

- supporting answers with written justification using precise mathematical notation and language **FA**
- making sound mathematical verbal arguments using precise language **IA**

VA. Students will identify, understand and accept the rights and responsibilities of belonging to a diverse community by

- actively participating in class discussions **IA**
- respecting each others' questions and responses, both in and out of class **IA**
- collaborating outside of class on Take Home and other assignments without infringing on each others' intellectual capital **IA**

VB. In order for students to make reasoned decisions which reflect ethical standards, and act in accordance with those decisions, students

- collaborate outside of class on assignments without infringing on each others' intellectual capital **IA**
- produce their own work on formal assessments **FA**

Instructional Design and Approach:

Students are expected to put forth sincere effort each day for this course. Their homework may be checked, but is not usually collected or graded. This policy exists, in part, because the material tends to be rather difficult for many people and the instructor does not want them to work 2 to 3 hours nightly when they are regularly stuck on a problem or two. They should collaborate with peers and then bring their questions to class, or to the instructor out of class if confusion persists.

While the homework does not contribute directly to any percentage of their grade, doing it will lead to a greater understanding of the material and thus higher test scores. Being diligent and thorough with the homework will also assist in developing dynamic class discussions, which is the student's responsibility as well as the instructor's. Finally, the consistency and sincerity of the effort being put into the homework will be considered when determining the final grade in borderline situations.

If a student is absent the day of a test, he or she will be expected to take the test the next day. Exceptions will be made for extended absence.

If a student is eligible for extended-time testing and wants to utilize this, he or she should contact the teacher in advance of a test to make arrangements. Students should expect to find a time to take tests in one sitting, when at all possible.

Students are encouraged to think independently and draw upon experiences from other classes as a natural part of the investigative process. Students are expected to delve

deeply into content, forming rigorous and broad connections within and among concepts. Communication is the tie that binds collaboration and investigation. It allows students to work together and share ideas, allows the teacher to assess and to push students further, and it helps students to monitor their own understanding.

All policies in the *IMSA Student Handbook* will be followed.

Assessment Practices, Procedures, and Processes:

Quarterly grades will be averaged using the following weightings:

Tests	60%
Quizzes	20%
Classwork*	20%

The course sequence and assessment system are somewhat flexible. The above categorical percentages are the initial intent, but might change slightly.

* Problem Sets, Group Work, Homework,…

Semester grades will be averaged using the following weightings:

Cumulative Semester Work	80%
Semester Exam	20%