Comprehensive Course Syllabus

BC Calculus 1/2

Course Description:

BC Calculus 1/2 covers essentially the same topics as the traditional BC Calculus 1 course and the first half of BC Calculus 2. Beyond learning the basic mechanics, students will learn how to think about calculus *mathematically*; that is, students will understand how calculus is formulated as a discipline. Emphasis is placed on a conceptual understanding of important concepts well beyond the learning of essential skills. In addition, students are required to creatively apply their knowledge, whether it be in the form of solving complex problems, writing expository text, or posing and solving research problems. This course, in conjunction with BC Calculus 2/3, also prepares the students for the AP Calculus BC exam given in May.

Instructor:

- Matthew McCutcheon
- Office Number: A-157, The Math Team Office
- Telephone number: (W) 630-907-5484
- Email address: mmccutcheon@imsa.edu

Availability:

Often Modules 2-5. Also afterschool from 4:15-4:45 PM.

Students should take advantage of these times for individual consultation – the instructor enjoys doing this! Making an appointment would be helpful and would guarantee time for the student, however, this is not necessary.

Text / Materials:

Calculus, 5th edition. Hughes-Hallet, Gleason, et al. Wiley. 2009.

Additional handouts will be provided by the instructor.

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

Applications of the derivative and theory
- Position, velocity, acceleration
- Optimization
- Related Rates
- L'Hôpital's Rule
- Intermediate Value Theorem, Extreme Value Theorem
- Mean Value Theorem

Understanding integrals
- Integral as signed area
- Integral as accumulation of a rate of change
- Basic properties – geometric and algebraic

Defining the Integral and theory
- Approximations of integrals
- Riemann sums
- Definition of an integral
- Fundamental Theorem of Calculus

Computations of integrals
- Antiderivatives of elementary functions
- *u*-substitution

SSLs and Outcomes:

FA: Formally assessed, IA: Informally assessed

IA. Students 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 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 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 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	50%
Quizzes	20%
Other*	20%
Discretionary**	10%

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

The grading scale for each assessment will be determined by the instructor. A percentage system will likely not be used.

* Problem Sets, Group Work, Homework,…

**In most cases this grade will be consistent with the student's average work, but the instructor does reserve the option of using his professional judgement about slight adjustments to that average. If this occurs, he will address that in the comments.

Semester grades will be averaged using the following weightings:

1st and 2nd Quarterly Grades	80%
Semester Exam	20%