AP CALCULUS BC 2011-2012
COURSE SYLLABUS

Instructor: Andrew J. Spieker   **E-mail**: delve-calcbc-teachers@mit.edu

Location: TBA   **Course Time**: Sundays from 10:00 to 3:00

Text: Calculus of a Single Variable by Larson et al.

Course Description: Advanced placement Calculus BC covers a two-semester sequence of college calculus. The four major topics of the course covered are differential calculus, integral calculus, polynomial approximations of functions, and the calculus of planar curves. The major aim of the course is, naturally, to prepare students for the advanced placement examination offered by the College Board in May of 2012. Doing well on the examination may exempt you from having to take calculus in college at some universities; some universities even offer credit.

The first semester approximately covers what would be considered "Calculus 1" at a typical university; the second semester approximately covers what would be considered "Calculus 2". In this classroom, you will get a good course in calculus (meaning, nothing is left out of our curriculum that you would get in most other calculus courses). Additionally, we will prove most of the major theorems we discuss (unless its proof involves theory that is well beyond the scope of the course). In the past, there has been some confusion about what the difference between AB and BC calculus is, and how it relates to "Calculus 1" and "Calculus 2". Unfortunately, these questions aren't easily reconciled, since AB covers more than just "Calculus 1". In plain terms, BC calculus includes all topics of AB plus a few additional topics. BC calculus content tends NOT to be more challenging than AB content, but more topics are covered in a the same amount of time. My recommendation is not to think too hard about these issues…to help put your mind at ease if you have any questions about this, "BC only" topics are marked as such on the course outline with a dagger symbol.

Assignments & Grades: The course contract contains more information about assignments, assessments, and grades and how they will work. In short, the semester's grade will be determined by the following weighting system:

Semester 1 Grading System:

Seven homework assignments:	20% Total (Not evenly weighted)
Three tests + two quizzes:	45% Total (Not evenly weighted)
Mid-year exam:	25%
Attendance and Participation:	10%

Semester 2 Grading System:

Seven homework assignments:	10% Total (Not evenly weighted)
Six quizzes:	50% Total (Not evenly weighted)
Final exam:	30%
Attendance and Participation:	10%

Other Information, Policies, and More: Please refer to the course contract for all information on policies, more detailed information about grading, assignments, etc. The next page begins the topical outline of the entire course.

Office Hours and Extra Help: There are no physical office hours—I don't have an actual office. However, depending on student interest, there may be virtual office hours or something to that effect. I will make myself available as early as 9:30 and as late as 4:00 if you give me advance notice for coming in early and/or staying late for extra help.

Topical Course Outline*

Semester 1 – Differential Calculus and Introduction to Integral Calculus

Unit "0-1" (Two Weeks) – Review of Precalculus; Limits and Continuity

    Week 1 (September 18, 2011)**:**   Review!
                                              Introduction to limits; Limits and techniques for evaluating limits

    Week 2 (September 25, 2011)**:**   Limits and techniques for evaluating limits
                                              Point-wise continuity
                                            The intermediate value theorem and the extreme value theorem

Unit 2 (Four Weeks) – The Definition of the Derivative and Rules for Differentiation

    Week 3 (October 2, 2011)**:**   Average rate of change
                                              Instantaneous rate of change and the definition of the first derivative
                                            The power rule and basic derivative rules

    Week 4 (October 9, 2011)**:**   The product, quotient, and chain rules
                                              Applications to physics and motion

    Week 5 (October 16, 2011)**:**   Derivatives of trigonometric functions
                                              Implicitly defined functions and implicit differentiation
                                            Higher order derivatives

    Week 6 (October 23, 2011)[S]**:**   Differentiability as local linearity
                                              Differentials and linearization
                                            Newton's method for approximating zeros of a function

Unit 3 (Two Weeks) – Curve Sketching and Graph Analysis

    Week 7 (October 30, 2011)**:**   Rolle's Theorem and the Mean Value Theorem
                                              Increasing and decreasing functions
                                          Critical points and the first derivative test

    Week 8 (November 6, 2011)**:**   Concavity and convexity
                                              Inflection points and the second derivative test
                                            Techniques for curve sketching and graph analysis

Unit 4 (Two Weeks) – Applications of Differentiation

    Week 9 (November 13, 2011)**:**   Related Rates; Optimization

    Week 10 (November 27, 2011)**:**   Applications Continued
                                              L'Hôpital's rule[†]

                                            (Beginning of Unit 5)
                                            Riemann sums
                                            LRAM, RRAM, MRAM, and trapezoid approximations of area
                                            The definite integral

Unit 5 (Four Weeks) – Riemann Sums and the Definite Integral

    Week 11 (December 4, 2011)**:**   The first fundamental theorem of calculus
                                              The second fundamental theorem of calculus
                                            Indefinite integrals and antidifferentiation

Week 12 (December 11, 2011):	Applications to physics and modeling real-life situations
Week 13 (December 18, 2011):	Substitution and coordinate changes in definite and indefinite integrals
	Average value of a function on an interval
	Area bounded between curves
Week 14 (January 8, 2012):	Arc Length†
	Improper Integrals†
	Mid-Year Examination Review
Midterm Day (January 15, 2012):	MID-YEAR EXAMINATION!

Semester 2 – Applications to Integral Calculus, Polynomial Approximations, and Planar Curves

Unit 6 (Two Weeks) – Applications to Integration: Solids of Revolution; Work

Week 15 (January 22, 2012):	Volumes of solids by slicing
	Volumes of solids by disks and washers
Week 16 (January 29, 2012):	Work; springs, pumping, and lifting
	Hooke's Law

Unit 7 (One Week) – Calculus of Transcendental Functions

Week 17† (February 5, 2012):	Calculus with the exponential and logarithm functions
	Calculus of inverse functions in general
	Calculus with inverse trigonometric functions

Unit 8 (One Week) – Techniques for Antidifferentiation

Week 18 (February 12, 2012):	Integration by parts
	Partial fraction reduction
	Trigonometric substitution
	General integration techniques

Unit 9 (Two Weeks) – Infinite Series of Real Numbers and Convergence Tests

Week 19† (February 19, 2012):	Infinite series of real numbers
	Geometric series
	p-series
	Direct and limit comparison tests
Week 20† (February 26, 2012):	The ratio test
	The root test
	Alternating series and the alternating series test

Unit 10 (Two Weeks) – Infinite Series of Functions

Week 21† (March 4, 2012):	Power series of functions
	Finding the radius and interval of convergence for power series
Week 22† (March 18, 2012):	The Taylor series of a function
	Finding a Taylor series
	Controlling error on Taylor series

<u>Unit 11 (Two Weeks) – Vector Functions, Parametric Equations, and Polar Coordinates</u>

Week 23† (March 25, 2012)**:**   Parametric equations and vector valued functions
Modeling motion and physics applications
Calculus with parametric equations and vector valued functions

Week 24† (April 1, 2012)**:**   Polar coordinates; polar functions and their graphs
Calculus with polar coordinates

<u>Unit 12 (One Week) – Differential Equations</u>

Week 25† (April 15, 2012)**:**   Differential equations
Slope fields
Separable differential equations
Euler's method for approximating solutions to a differential equation†
Population models and logistic growth; phase diagrams†

<u>Crunch Month! – Review, Etc.</u>

Week 26 (April 22, 2012)**:**   Review for Practice Final Exam

Week 27 (April 29, 2012)**:**   Practice Exam (Final Exam)

Week 28 (May 6, 2012)**:**   Practice Exam (Final Exam)

* Note that from year to year, it is impossible to determine exactly what topics students will find easier and what topics students will find more difficult. One advantage of this course is that we are not tied to a particular structure; therefore, it is possible that we will speed up or slow down as necessary, thus changing the timing indicated on this sheet. It will be my responsibility to inform you of such changes, and provide you with a new/updated topical outline; it will be your responsibility to keep up with such changes and ask questions if anything is unclear!

† Indicates BC only content. In the event that all topics for the week are BC content, this symbol is put by the week number; otherwise, just by the topic itself.

§ Indicates Spicy Delve week. This course will run from 10-12, with seminar class from 1-3.