Antioch University Los Angeles
Undergraduate Studies
Math 191: Calculus I
4 semester units

Instructor: Katie Kondo, M.S.
Class Meeting Times & Place: Week of August 17, 2015 – Week of December 14, 2015 (5 days per week)
Office Hours: Tuesday & Thursday, 8:00 am-9:00 am and by appointment
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Course Description: The course aims to apply and extend what students have learned in previous mathematics courses through the study of limits, derivatives, and integrals, along with basic differentiating and integrating techniques. The course starts with five major problems that introduce the big ideas of calculus: limits, exponential functions, the relationship between distance and velocity, piecewise functions, and the Fundamental Theorem of Calculus. Derivative techniques and applications will include related rates, implicit differentiation, optimization, and the Mean Value Theorem. Integration techniques and applications will include areas between curves, u-substitution, and volumes. Each of these five major problems is revisited again later in Math 192 for students to solve using new calculus knowledge. Students in Calculus will continue to use problem solving strategies, questioning, investigating, and explaining in conjunction with their knowledge of the connections among algebra, geometry and functions to analyze problems and formulate solutions. Throughout, they will also use these strategies to extend their current knowledge by making new connections. The course is a college level course and requires a significant amount of preparation for every class on the part of the student.

Undergraduate Studies Learning Objectives

- Critical and analytical thinking ability;
- The ability to understand issues from multiple perspectives;
- The ability to connect learning to lived experience;
- Social and intercultural awareness,
- Civic and community engagement;
- Core competency in foundational skills: including, writing, quantitative reasoning, information literacy, technological literacy, oral communication, and research.

Course Learning Objectives:
Students successfully completing the course will be able to:

- Students will be able to work with functions represented in a variety of ways: graphical, numerical, analytical, or verbal. They will understand and be able to explain the connections among these representations with respect to the derivative and definite integral.
    - Use limits to define continuity and see how continuity provides the basis for the Intermediate Value Theorem.
- Students will understand and be able to explain the meaning of the derivative in terms of a rate of change and local linear approximation, and should be able to use derivatives to explain and solve a variety of problems.
    - Derive and use the formal definition of a derivative as the limit of the slope of a secant

line.
    - Find derivatives of sine, cosine, and formalize the Power Rule.
    - Discover what 1st and 2nd indicate about a function's shape, including where it is increasing, decreasing and its concavity.
    - Sketch *f'(x)* and *f''(x)* from *f* (x) . Connect first and second derivatives with velocity and acceleration.
    - Distinguish between maximum and minimum values using the first and second derivatives.
    - Develop more derivative techniques: Product Rule, Quotient Rule, and Chain Rule. Find the derivatives of sec(x) , csc(x) , tan(x) , and cot(x) .
    - Revisit exponential functions and study their derivatives.
    - Use implicit differentiation as a tool to differentiate relations that are not solved explicitly for *y.*
    - Find the derivatives of *all* parent graphs and their inverses.
- Students will understand and be able to explain the meaning of the definite integral both as a limit of Riemann sums and as the net accumulation of change, and should be able to use integrals to explain and solve a variety of problems.
    - Approximate the area under a curve using Riemann sums and summation notation. Predict function behavior with limits.
    - Set up and evaluate an integral to find the exact area under a curve.
    - Calculate the area of a region between curves.
    - Evaluate improper integrals.
- Students will understand and be able to explain the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
    - Develop a process to find the mean value of a function, as well as an average rate of change for a function.

Evaluation Criteria:
The final evaluation will address the extent to which students have met the learning objectives listed above, as demonstrated in:

- Active contributions to small group and classroom discussion demonstrating constructive dialogue with peers
- Development of understanding of the selected texts and analytical skills over the course of the term, including in projects, quizzes, and exams.

Additionally, the specific components of the course grade are constructed as follows:

- Participation 5%
- Quizzes & Chapter Exams 35%
- Homework Assignments/Problem Sets 15%
- Other Written and Collaborative Projects 20%
- Final Exam 25%

The homework in the "Review & Preview" section of each lesson reinforces skills and concepts learned in the lesson, as well as practices and enriches previously introduced material and prepares students for

upcoming topics. The homework problems also allow students to apply concepts and skills in new contexts and to deepen their understanding by solving the same type of problem in different ways.

Required Text:

Cho, C. (Ed.). (2010). *College Preparatory Mathematics: Calculus*. Sacramento, CA: CPM Educational Program.

***Tentative* Schedule, Outline of Class Activities, Lessons, Assessments & Assignments:**

Chapter 1: A Beginning Look at Calculus

Weeks 1-2

Section	Lesson	Days	Lesson Objectives	Materials	Homework
1.1	1.1.1	1	Applying Rates and Distance	Lesson 1.1.1 Res. Pg.	1-2 to 1-10
1.2	1.2.1	1	Piecewise Functions and Continuity	None	1-20 to 1-28
	1.2.2	1	End Behavior and Horizontal Asymptotes	None	1-36 to 1-43
	1.2.3	1	Holes, Vertical Asymptotes, and Approach Statements	None	1-51 to 1-60
	1.2.4	1	Composite Functions and Inververse Functions	None	1-68 to 1-76
	1.2.5	1	Attributes of Even and Odd Functions	None	1-82 to 1-91
	1.2.6	1	Design a Flag (optional)	None	1-93 to 1-95
1.3	1.3.1	1	Finite Differences	None	1-101 to 1-109
	1.3.2	1	Slope Statements and Finite Differences of Non-Polynomials	None	1-113 to 1-121
	1.3.3	1	The Slope Walk	• CBL with Motion Detector or CBR • Distance/Time program • Overhead graphing calculator (or computer display)	1-125 to 1-132

1.4	1.4.1	1	Distance and Velocity	• CBL with Motion Detector or CBR	1-138 to 1-146
	1.4.2	1	Average Velocity on a Position Graph	• Lesson 1.4.2 Res. Pg. • Colored pencils	1-152 to 1-161
	1.4.3	1	Average Velocity on a Velocity Graph	None	1-167 to 1-175
	1.4.4	1	Acceleration	None	1-181 to 1-189
1.5	1.5.1	1	Area and Slope	Lesson 1.5.1 Res. Pg.	1-194 to 1-203
Chapter Closure		Varied Format Options			

Chapter 2: Rates, Sums, Limits, and Continuity

Weeks 3-5

Project: The students will build and analyze a Rube Goldberg Invention that will fulfill certain continuity requirements on its position graph. Students will also create an instruction manual that outlines their design, writes statements about the increasing/decreasing distance, velocity, and acceleration at different times, find instantaneous rates of change at different times, and in discontinuous situations, find limits of the velocity curve from the left and the right. These projects will be presented to a panel of judges (engineers, mathematics professors, and Da Vinci staff members).

Section	Lesson	Days	Lesson Objectives	Materials	Homework
2.1	2.1.1	1	Area Under the Curve Using Trapezoids	None	2-7 to 2-14
	2.1.2	1	Methods to Easily Calculate Area	None	2-20 to 2-28
	2.1.3	1	Area Under the Curve as a Riemann Sum	None	2-35 to 2-41
2.2	2.2.1	1	Introduction to Limits as Predictions	None	2-49 to 2-56
	2.2.2	1	Intuitive ideas of Continuity	None	2-64 to 2-72
	2.2.3	1	Definition of Continuity	None	2-81 to 2-88
	2.2.4	1	Evaluating Limits	None	2-95 to 2-101
2.3	2.3.1	1	Ramp Lab	• Ramps (wheel chair or long board) • Measuring taps or meter/yard sticks • Balls or marbles • Stop watch • Sticky notes	2-104 to 2-111
	2.3.2	1	Sudden Impact	None	2-114 to 2-121
	2.3.3	1	Local Linearity	None	2-125 to 2-131
2.4	2.4.1	1	Improving Approximation	None	2-136 to 2-145
Chapter Closure			Varied Format Options		

Chapter 3: Slope and curve analysis

Weeks 6-8

Project: Students will select a real-life coastline and create a training program for coast guard members to find emergency situations. They will use a piecewise function to model the coastline and create clues using the derivative for the views and paths of a few ships and observers from different points along the coast. This will encourage the students to see the ways that the 1st and 2nd derivatives shape and practice with finding the derivatives of parent functions.

Section	Lesson	Days	Lesson Objectives	Materials	Homework
3.1	3.1.1	1	The Power Rule	• Lesson 3.1.1 A - C Res. Pgs. or poster sized graph paper	3-9 to 3-18
	3.1.2	1	Secants to Tangents, AROC to IROC	None	3-27 to 3-34
3.2	3.2.1	1	Definition of a Derivative	None	3-42 to 3-51
	3.2.2	1	Derivatives Using Multiple Strategies	None	3-58 to 3-67
	3.2.3	1	Derivatives of Sine and Cosine	Poster sized graph paper (optional)	3-73 to 3-81
3.3	3.3.1	1	Curve Constructor: Part I	• Sticky notes (optional)	3-87 to 3-95
	3.3.2	1	The Shape of a Curve	• Lesson 3.3.2 A - F Res. Pgs. (optional) • Colored pens or pencils • Poster board or paper	3-101 to 3-110
	3.3.3	1	Curve Sketching: Derivatives	• Lesson 3.3.3 Res. Pg. or poster sized graph paper • Markers or stickers (dots)	3-113 to 3-123
	3.3.4	1-2	The First and Second Derivative Tests	• Motion detectors	3-130 to 3-140
3.4	3.4.1	1	Conditions for Differentiability	• Overhead graphing calculator (optional)	3-147 to 3-155
	3.4.2	1	Curve Constructor: Part II	• Overhead graphing calculator (optional) • Sticky notes (optional)	3-161 to 3-169
	3.4.3	1	Differentiability of Specific Functions	None	3-174 to 3-181
	3.4.4	1	Intersection of Tangents	• Lesson 3.4.4 Res. Pg.	3-183 to 3-190
Chapter Closure		Varied Format Options			

Chapter 4: The Fundamental Theorem of Calculus
Weeks 9-11
Project: Students will participate in a mock trial, using their knowledge of velocity, position, and acceleration and the Fundamental Theorem of Calculus to build an argument for/against and solve a teacher's speeding violation case.

4.1	4.1.1	1	Definite Integrals	None	4-6 to 4-12
	4.1.2	1	Numerical Cases of Definite Integrals	Graphing calculator	4-18 to 4-26
	4.1.3	1	Properties of Definite Integrals	None	4-31 to 4-39
4.2	4.2.1	1	Deriving "Area Functions"	None	4-43 to 4-51
	4.2.2	1	Indefinite and Definite Integrals	None	4-56 to 4-64
	4.2.3	1	The Fundamental Theorem of Calculus	None	4-73 to 4-80
	4.2.4	1	The Fundamental Theorem of Calculus	None	4-86 to 4-94
4.3	4.3.1	1	Fast Times: Parts 1 & 2	None	4-98 to 4-105
	4.3.2	1	Fast Times: Parts 3 & 4	None	4-108 to 4-115
	4.3.3	1	Fast Times: Part 5	None	Closing Statement Write-up
4.4	4.4.1	1	Area Between Curves	None	4-123 to 4-130
	4.4.2	1	More Area Between Curves	None	4-135 to 4-144
	4.4.3	1 - 2	Multiple Methods for Finding Area Between Curves	Lesson 4.4.3 Res. Pg.	4-150 to 4-157
4.5	4.5.1	1	Newton's Method (optional)	Lesson 4.5.1 Res. Pg.	4-162 to 4-168
Chapter Closure		Varied Format Options			

Chapter 5: Optimization and derivative tools
Weeks 12-14
Project: Students will create a new map of the school that optimizes space in the hallways, distance between classes, yet maintains necessary structures. This will allow them to utilize their new derivative techniques including the product rule, quotient rule, and chain rule, to build the most efficient campus map.

Section	Lesson	Days	Lesson Objectives	Materials	Homework
5.1	5.1.1	1	Distance, Velocity, and Acceleration Functions	None	5-5 to 5-11
	5.1.2	1	Optimization	• Lesson 5.1.2 Res. Pgs. • Scissors and tape	5-14 to 5-20
	5.1.3	1	Using the 1st and 2nd Derivatives	None	5-25 to 5-32
	5.1.4	1	Applying the 1st and 2nd Derivative Tests	None	5-39 to 5-46
5.2	5.2.1	1	The Product Rule	None	5-51 to 5-58
	5.2.2	1	Chain Rule and Application: Part I	None	5-68 to 5-75
	5.2.3	1	Chain Rule and Application: Part II	None	5-79 to 5-86
	5.2.4	1	Quotient Rule: Two Proofs	None	5-93 to 5-99
	5.2.5	1	More Trigonometric Derivatives: $\tan x$, $\cot x$, $\sec x$, and $\csc x$	None	5-103 to 5-109
5.3	5.3.1	1	Optimization Problems: Part I	None	5-112 to 5-117
	5.3.2	1	Optimization Problems: Part II	None	5-122 to 5-127
	5.3.3	1	Optimization Problems: Part III	None	5-130 to 5-137
5.4	5.4.1	1	Chain Rule Extension of the Fundamental Theorem of Calculus	None	5-141 to 5-147
5.5 (BC)	5.5.1	1	Finding Limits of Indeterminate Forms	None	5-154 to 5-160
	5.5.2	1	Using l'Hôpital's Rule	None	5-167 to 5-173
Chapter Closure			Varied Format Options		

Chapter 6: More derivative tools
Weeks 15-16
Project (continued from Ch 5): Students will create a new map of the school that optimizes space in the hallways, distance between classes, yet maintains necessary structures. This will allow them to utilize their new derivative techniques including the product rule, quotient rule, and chain rule, to build the most efficient campus map.

Section	Lesson	Days	Lesson Objectives	Materials	Homework
6.1	6.1.1	1	Exponential Functions	• Posters from problem 1-4	6-8 to 6-16
	6.1.2	1	Derivatives of Exponential Functions	None	6-23 to 6-29
	6.1.3	1	Derivatives Using Multiple Tools	None	6-34 to 6-40
	6.1.4	1	Integrals of Exponential Functions	None	6-46 to 6-54
6.2	6.2.1	1	Implicit Differentiation	• Overhead graphing calculator (optional)	6-59 to 6-66
	6.2.2	1	Implicit Differentiation Practice	None	6-71 to 6-78
6.3	6.3.1	1	Inverse Trigonometric Derivatives	None	6-82 to 6-87
	6.3.2	1	Inverse Trigonometric Derivatives: The Formulas	None	6-91 to 6-96
	6.3.3	1	Derivatives of Natural Logarithms	None	6-101 to 6-106
	6.3.4	1	Derivatives of Inverse Functions	• Lesson 6.3.4 Res. Pg.	6-114 to 6-119
6.4	6.4.1	1	Mean Value	• Lesson 6.4.1 Res. Pg. • Interlocking cubes	6-125 to 6-133
	6.4.2	1	Mean Value Theorem	• Lesson 6.4.1 Res. Pg.	6-140 to 6-149
	6.4.3	1	Mean Value Theorem: Applications	None	6-158 to 6-163
6.5 (BC)	6.5.1	1	Improper Integrals	None	6-168 to 6-174
Chapter Closure			Varied Format Options		

Semester Review
Course Evaluation

Assessments:
Group Project Presentations
Final Exam

Further Readings:

Leithold, L. (1995). *The Calculus 7.* New York, NY: Harpercollins College Division.
Stewart, J. (2011). *Calculus.* Independence, KY: Brooks Cole.

Course and University Policies:

Application and Registration

All students new to AULA courses must apply online to AULA to receive a username and password and must register for all courses for the semester on myAntioch. Guidelines and procedures to be discussed in class beginning Week 2 of the course. **Registration is to be completed by Week 3 of the course. Failure to register for the course will result in the student losing the opportunity to earn college credit for the course through Antioch University Los Angeles.**

Attendance Policy

Students are expected to attend all class sessions and participate as required. Students missing more than 4 class sessions must make up the missed time by completing assignments per instructor's direction. Students missing more than 10 class sessions will not receive credit for the course. See *AULA General Catalog, http://aulacatalog.antioch.edu/policiesregulationsandprocedures/academicpolicies/* for university policy.

Incomplete Policy

Per university policy, students must complete all course work by the deadlines stated in the syllabus.
If a student anticipates not being able to complete required work by the end of the term, the student may request an Incomplete from the instructor. Incompletes are awarded at the discretion of the instructor. See *AULA General Catalog, http://aulacatalog.antioch.edu/policiesregulationsandprocedures/academicpolicies/* for university policy.

Information Literacy and Research Requirements

All students are expected to develop an understanding of how to find and use resources appropriate for academic inquiry and scholarship. General instruction and guidance will be provided in class; students are also encouraged to attend office hours for help and support with research and for information literacy instruction.

Student Conduct and Class Policies

- All students are expected to be on time to every class and bring all necessary materials.
- Students are expected to conduct themselves professionally and interact respectfully with instructor and peers at all times.
- Students must turn in all assignments on time (on Edmodo by the due date, or at the beginning of the class period they are due *unless* other arrangements are made with the instructor *in advance*).
- Late work, including projects, are only accepted at the instructor's discretion. Late work and lack of preparation for class will also lead to a reduction in a student's accountability grade.
- Essays and projects may be revised and re-submitted with instructor consent; students must attend office hours to discuss the work and re-submit within two weeks of receiving the initial grade.

- If a student is going to be absent on the day of a quiz or exam, it is his or her responsibility to arrange a date to make up the exam. If a student does not make arrangements *in advance*, the instructor may not be able to accommodate the request.
- If a student misses class, all material covered during the student's absence and work assigned remain the student's responsibility.
- Students who miss class are expected to attend office hours as soon as possible.
- Important announcements and assignments will be communicated via Edmodo.com. All students must have a username and password, and log in regularly. (Instructions and access code will be given the first week of the semester.)

Respectful conduct is expected of students on the campus at all times, both inside and outside the classroom. See *AULA General Catalog, http://aulacatalog.antioch.edu/policiesregulationsandprocedures/studentconduct/* for further details re: Antioch University Los Angeles policy. Students are expected to respect and adhere to all Da Vinci Science rules and policies at all times as well.

Academic Integrity & Plagiarism Policy

AULA and DaVinci Schools expect all students to adhere to the highest standards of academic honesty. In all academic activities—including, but not limited to papers, oral presentations, and reports—students must submit their own original work accompanied by citations acknowledging words, facts, or ideas borrowed from any other source, including electronic sources.

Plagiarism – that is, the intentional or unintentional borrowing of another person's ideas, images, research, or data without citation -- is a serious breach of academic integrity that results in sanctions, including dismissal from the University. University policy describes plagiarism as "the representation of someone else's writing, graphics, research, or ideas as one's own. Paraphrasing an author's ideas or quoting even limited portions of the work of others without proper citation are also plagiarism, as is cutting and pasting materials from the Internet into one's academic papers. Extreme forms of plagiarism include submitting a paper written by another person or purchased from a commercial source. Students should be aware that AULA has access to software for detecting plagiarism.

Please consult the Purdue Online Writing Lab http://owl.english.purdue.edu/owl/resource/589/01/ for specific guidance on avoiding plagiarism while taking notes, summarizing, paraphrasing, and quoting from sources. For history courses, additional information will be provided for citations using the Chicago/Turabian format. **Students committing plagiarism or academic dishonesty will be also be subject to disciplinary action from DaVinci Schools as well as from the university.**

Reasonable Accommodation for Students with Disabilities

Antioch University is committed to providing reasonable accommodations to qualified students with disabilities in accordance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 2008. Students who need to request disability accommodations should email studentaffairs.aula@antioch.edu at the outset of their enrollment, if possible, since reasonable accommodations are not retroactive.

Sexual Harassment Policy

The Undergraduate Studies Division is firmly committed to each student's dignity and to eliminating all forms of sex discrimination and harassment of students. No student should have her or his learning experience at AULA contaminated by the experience of being treated as a sexual object by an instructor or any other employee. We strongly urge any student who believes that an Antioch employee has crossed the line to speak to your advisor, to the Undergraduate Studies Division leadership, the Director of Human Resources, or the Provost about your concerns.

Antioch University's policy "Title IX, Sex Discrimination, Sexual Harassment, and Sexual Violence" provides definitions of prohibited and inappropriate behaviors, the process for reporting and investigating complaints, and the sanctions levied against those employees or students found to be in violation of these policies. This policy can be found in the Antioch University Resource Archive at http://aura.antioch.edu/policies_400_6x/12/.

Additionally, please see the *AULA General Catalog* for the policy on dual relationships: http://aulacatalog.antioch.edu/policiesregulationsandprocedures/universitypolicies/relationshipsintheworkplace/.

Antioch University Policies:

Antioch University is committed to building a vibrant and inclusive educational environment that promotes learning and the free exchange of ideas. Our academic and learning communities are based upon the expectation that their members uphold the shared goal of academic excellence through honesty, integrity, and pride in one's own academic efforts and respectful treatment of the academic efforts of others.

All students are expected to comply with Antioch University policies, including the Title IX Sexual Harassment and Sexual Violence Policy and the Student Conduct Policy. Respectful conduct is expected of students on the campus at all times, both inside and outside the classroom.

To access academic, student, and other university policies are available online: http://aura.antioch.edu/au_policies/