**MA 201: Differential Calculus** **Spring 2018 Syllabus**
**Alabama School of Math and Science** **Instructor:** Sarah Brewer
**Classroom/Office:** S201 **Office Phone:** 251.441.2127
**Web site:** mathemartiste.com **Email:** sbrewer@asms.net (best way to contact me)
**Office Hours:** Mon, Wed, Fri 10:00 (3rd per) & 1:45 (7th per); Wed 3:45 (9th per/"after school")
**Math Lab (free tutoring):** Sunday-Thursday 6:30-8:30pm in S201
**Khan Academy Coach Code:** H6HR7TBH

**Course Description:** This introduction to the theory, techniques, and applications of differential calculus includes functions, limits, derivatives, related rates, maximum/minimum problems, and curve sketching.
**Prerequisites:** A or B in MA103 Trigonometry and MA104 Precalculus or permission of the department.
**Next in Sequence:** This course fulfills the ASMS graduation requirement in Mathematics.
Students wishing to take the AP Calculus AB or BC Exam next year should enroll in Integral Calculus and Differential Equations (for AB exam), followed by BC Calculus and Multivariable Calculus I (for BC exam).
**Text:** Larson & Edwards, *Calculus,* 10th edition. **Coverage:** 1.2-1.5, 2.1-2.6, 3.1-3.5, 3.7, 5.1, 5.4-5.6, 8.7

The Content for the Differential & Integral Calculus Sequence is based on three big ideas:
**Big Idea 1 – Limits (Chapter 1)**: Computing limits graphically and numerically, Continuity
$f$ is continuous at $c$ if and only if (1) $f$ is defined at $c$, (2) $\lim_{x\to c} f(x)$ exists, and (3) $\lim_{x\to c} f(x) = f(c)$
**Big Idea 2 – Derivatives (Chapter 2-3)**: Defining the derivative, Mean Value Theorem
$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ $f'(c) = \lim_{x\to c} \frac{f(x)-f(c)}{x-c}$
If $f$ is continuous on $[a, b]$ and differentiable on $(a, b)$, then there exists $c \in (a, b)$ such that $f'(c) = \frac{f(b)-f(a)}{b-a}$
**Big Idea 3 – Integrals and the Fundamental Theorem of Calculus**: Defining the definite integral, the first Fundamental Theorem of Calculus, the Second Fundamental Theorem of Calculus
If $f$ is continuous on $[a, b]$ then the function $g$ defined by $g(x) = \int_a^x f(t)dt$ is an antiderivative of $f$. That is, $g'(x) = f(x)$ for $a < x < b$.
If $f$ is continuous on $[a, b]$ then $\int_a^b f(x)dx = F(b) - F(a)$, where $F(x)$ is any antiderivative of $f(x)$.

**Required Materials:** 3-ring binder with notebook paper and dividers
Students should regularly update this notebook with reflections on assignments, performance, and learning. Dividers should be labeled as follows:

1. Handouts – This section should include the syllabus, formula sheets, photocopies of supplementary texts, or any other materials that are distributed in class that do not fall into another category.
2. Lecture Notes – This section should include any notes taken by the student from class lectures, the textbook, and videos, including any handouts with fill-in note slides, clearly labeled with the date and section or topic title, ordered according to date. Note that any lecture notes presented using the Smart Board will be exported in .pdf format and posted to my teaching web site for student convenience.
3. Problem Solving – This section should include problem sets assigned from the textbook and Khan Academy, and any other practice problems worked by the student to support the lecture notes. These should be labeled neatly with your name, date, textbook chapter & section and/or video/topic title as relevant, and problem numbers.
4. Quizzes/Tests/Projects – This section should include any Quizzes, Tests, Projects, Papers, and Reports, clearly labeled and in order by date.
5. Reflection – This section should include study guides with material grouped by chapter/section/topic, written reflections and corrections after each graded assignment is returned, and copies of any Progress Reports received by the student.

**Grade determination:** Grades will be assigned based on total points earned out of total points possible. Homework assignments and tests will be posted on Netclassroom. Khan Academy assignments will be given regularly. It is the student's responsibility to check these daily to make sure they are not missing anything. Grades will be posted on Netclassroom.

**Tests** are worth 100 points each, and will consist primarily of material covered since the prior test, but will also include some review questions. Tests will consist of questions similar to what students will see on the AP Calculus Exam. The final exam will be comprehensive and is worth 200 points.
Tentative test dates: Week 3, Week 6, Week 9

**Homework** assignments typically range in point value from 5-20 points, and should be labeled neatly with your name, date, textbook chapter & section and/or video title as relevant, and problem numbers. Since many textbook problems assigned will be odd-numbered, students should check their own work for accuracy and ask the instructor or Math Lab proctors to check even-numbered problems. Credit will not be given for answers copied from the back of the book or from another student. Show all of your own work. Some assignments may be submitted via turnitin.com. Assignments made on Khan Academy should be worked out on paper and kept in the appropriate notebook section. Even when not required, use of this resource is encouraged.

**Quizzes and other in-class assignments** typically range in point value from 10 to 50 points. Quizzes will be a combination of theory (rules, definitions, and formulas) and problems similar to and directly from homework assignments. Quizzes can occur any day of the week and may be announced or unannounced. If you miss a quiz with an excused absence for which a make-up quiz is not available, you will have fewer total possible points. If a make-up quiz is available, it must be made up within 3 days of a student's return to class. Quizzes missed due to unexcused absences will receive a grade of 0.

**Make-up policy:** Any homework checks, quizzes, or tests missed due to unexcused absences will receive a grade of zero. Homework assigned during a student's absence must be turned in within three days of the student returning to class. There are no make-up quizzes. Arrangements to make-up tests must be done BEFORE the test is missed. In case of unexpected illness, this can be done via email. Note: make-up assignments will, in general, be more difficult than the original.

**Cell phone policy:** Phones should be SILENT or OFF (not on vibrate) and away. I reserve the right to confiscate any phone that I deem a distraction. Use of cell phones during quizzes or tests will be considered academic dishonesty and result in a grade of zero. Occasionally, we may use smartphone apps in class, but phones should remain away unless otherwise specified.

**Attendance and Tardiness Policy:** Three tardies count as one unexcused absence. A student with three unexcused absences may be assigned a grade of WF for the course. Students are responsible for acquiring any missed notes and assignments (as these are posted on the web, this should not be a problem, but check with a classmate to see if you missed anything not posted).

**Tutoring:** All students are encouraged to attend my weekly Office Hours and the evening student-run Math Lab for help with homework and studying. Even if you do not have a specific question about the material, come by and work on your homework free from distractions and with math experts nearby to help. When you come, make sure you have both your notebook and textbook with you. The primary goal of tutoring is to help you figure out the answers for yourself, not to give you the answer, but if you get stuck, please speak up, even if a Math Lab proctor or myself are helping another student.

**Calculators:** Students will have in-class access to both scientific and graphing calculators.
For any out-of-class assignments requiring calculator use, students are encouraged to utilize wolframalpha.com and desmos.com. Calculators will not be allowed at all on many assignments.

## Mathematical Practices for AP Calculus (MPACs)

These are skills that real mathematicians use that you will practice this term and hopefully bring with you as you progress into higher-level mathematics courses. Consider these when writing reflections on your assignments.

**MPAC 1: Reasoning with definitions and theorems. Students can:**

- Use definitions and theorems to build arguments, to justify conclusions or answers, and to prove results.
- Confirm that hypotheses have been satisfied in order to apply the conclusion of a theorem.
- Apply definitions and theorems in the process of solving a problem.
- Interpret quantifiers in definitions and theorems (e.g., "for all," "there exists").
- Develop conjectures based on exploration with technology.
- Produce examples and counterexamples to clarify understanding of definitions, to investigate whether converses of theorems are true or false, or to test conjectures.

**MPAC 2: Connecting concepts. Students can:**

- Relate the concept of a limit to all aspects of calculus.
- Use the connection between concepts (e.g., rate of change and accumulation) or processes (e.g., differentiation and its inverse process, antidifferentiation) to solve problems.
- Connect concepts to their visual representations with and without technology.
- Identify a common underlying structure in problems involving different contextual situations.

**MPAC 3: Implementing algebraic/computational processes. Students can:**

- Select appropriate mathematical strategies.
- Sequence algebraic/computational procedures logically.
- Complete algebraic/computational processes correctly.
- Apply technology strategically to solve problems.
- Attend to precision graphically, numerically, analytically, and verbally and specify units of measure.
- Connect the results of algebraic/computational processes to the question asked.

**MPAC 4: Connecting multiple representations. Students can:**

- Associate tables, graphs, and symbolic representations of functions.
- Develop concepts using graphical, symbolical, verbal, or numerical representations with and without technology.
- Identify how mathematical characteristics of functions are related in different representations.
- Extract and interpret mathematical content from any presentation of a function (e.g., utilize information from a table of values).
- Construct one representational form from another (e.g., a table from a graph or a graph from given information).
- Consider multiple representations (graphical, numerical, analytical, and verbal) of a function to select or construct a useful representation for solving a problem.

**MPAC 5: Building notational fluency. Students can:**

- Know and use a variety of notations.
- Connect notation to definitions (e.g., relating the notation for the definite integral to that of the limit of a Riemann sum).
- Connect notation to different representations (graphical, numerical, analytical, and verbal).
- Assign meaning to notation, accurately interpreting the notation in a given problem and across different contexts.

**MPAC 6: Communicating. Students can:**

- Clearly present methods, reasoning, justifications, and conclusions.
- Use accurate and precise language and notation.
- Explain the meaning of expressions, notation, and results in terms of a context (including units).
- Explain the connections among concepts.
- Critically interpret and accurately report information provided by technology.
- Analyze, evaluate, and compare the reasoning of others.

## Differential Calculus Tentative Topic & Homework Schedule

Note that only some of the problems listed will be assigned for homework. Some will be assigned for classwork and some will not be assigned at all. You are expected to be able to work all problems listed for each section. Always check the answers to odd-numbered problems in the back of your book, and if your answer looks different, before reworking the problem or asking for help, check to see if there is an algebraic way to get from your answer to the one listed in the book.

Week 1 – February 26 – March 2

- Review based around Rational Functions
- 1.2 Finding limits graphically and numerically #1-6 all, 15-22 all
- 1.2 Epsilon-Delta definition of the limit #33,34,39,41 (page 56)

Week 2 – March 5-9

- 1.3 Evaluating limits analytically #11, 21, 27-61odd; 83,87
- 1.3 Limits with trig; Squeeze Theorem #63-73 odd; 89, 90
- 1.4 Discontinuity and one-sided limits #1-19 odd;27-30 all;43-48 all

Week 3 – March 12–16
(3/16 is 1st grade posting)

- **TEST 1 – LIMITS & CONTINUITY**
- 1.4 Continuity with Trig and Intermediate Value Theorem #21,23,25,57,61,65,69,99,102
- 1.5 Infinite limits #1,3,23; 29-57 odd
- Ch 1 review pp. 91-92 #3-83 odd

Week 4 – March 19-23
(3/20 is ACT for Juniors)

- 2.1 Find the derivative by the limit process; Find the equation of the tangent line #1-41odd
- 2.1 Use the alternate form to find the derivative; Describe the x-values where the function is differentiable (given a graph) #65-89odd
- 2.2 Find derivative using basic rules #3-67 odd

Week 5 – March 26-29 (3/29 is short day)

- 2.2 Use derivative to solve rate of change word problems #87-95 odd; 97-100 all; 105,106,111,113,115
- **TEST 2 – DEFINITION OF THE DERIVATIVE**

Week 6 – April 9-13 (4/13 is 2nd grade posting)

- 2.3 Product and quotient rules #1-53 odd, 63-85 odd, 91-105 odd, 111-115 odd
- 2.4 Chain rule #7-33odd; 43-89odd
- Logarithmic functions #41-59 odd,69,71
- 5.4 Exponential functions #33-51 odd,59,61
- 5.5 Log and exp functions with other bases #37-69 odd

Week 7 – April 16-20

- 5.6 Inverse trig functions #39-63 odd
- 2.5 Implicit Differentiation #1-39 odd; 43, 47
- **TEST 3 – DIFFERENTIATION**

Week 8 – April 23-27

- 2.6 Related Rates #15-27, 35
- 3.1 Absolute Extrema on an Interval # 17-35 odd

Week 9 – April 30 – May 4

- 3.3 Increasing, Decreasing, and Relative Extrema #23-35 odd
- 3.4 Inflection Points and Concavity #19-29 odd
- 3.2 Rolle's Theorem #11-21 odd
- 3.2 Mean Value Theorem #33-45 odd

Week 10 – May 7-11 (5/9 is 3rd grade posting)

- 3.5 Limits at Infinity #15-31 odd
- 8.7 L'Hopital's Rule #11-35 odd; #47-55 odd
- 3.7 Optimization #3,5,17,19,23

Week 11 – May 14-18 (5/18 is super short day)

- **TEST 4 – APPLICATIONS OF DERIVATIVES**
- Review

Final Exams – May 21-24