Millersville University, Spring 2016
MATH 616: Teaching AP Calculus
(Individualized Instruction)

Instructor: Dr. Janet A. White
Phone: Office: (717) 871-7320
E-mail: jwhite@millersville.edu
Office: Wickersham Hall 208B
Office hours: to be determined

Course Description:
MATH 616 Teaching Advanced Placement (AP) Calculus in the Secondary School (3) Current issues associated with the teaching of Advanced Placement calculus in the secondary school, including issues associated with teaching strategies as well as curricular issues. Central to this discussion will be the College Board publications on the AP calculus curriculum, AP calculus exams, and the use of technology in the AP calculus classroom. Prereq: Teaching experience or permission of instructor.
This course is designed for teachers who are or would like to teach AP Calculus in their districts. The course will reinforce and hold graduate students responsible for the mathematical content at the level expected of someone teaching AP Calculus.

Framework:

- Calculus AB and Calculus BC are primarily concerned with developing the students' understanding of the concepts of calculus and providing experience with its methods and applications. The courses emphasize a multi-representational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally. The connections among these representations also are important.
- Calculus BC is an extension of Calculus AB rather than an enhancement; common topics require a similar depth of understanding. Both courses are intended to be challenging and demanding.
- Broad concepts and widely applicable methods are emphasized. The focus of the courses is neither manipulation nor memorization of an extensive taxonomy of functions, curves, theorems, or problem types. Thus, although facility with manipulation and computational competence are important outcomes, they are not the core of these courses.
- Technology should be used regularly by students and teachers to reinforce the relationships among the multiple representations of functions, to confirm written work, to implement experimentation, and to assist in interpreting results.
- Through the use of the unifying themes of derivatives, integrals, limits, approximation, and applications and modeling, the course becomes a cohesive whole rather than a collection of unrelated topics. These themes are developed using all the functions listed in the prerequisites.

<The College Board, 2012 Philosophy for AP Calculus>

Course Objectives: Students will be able to teach their own students will be able to:

- work with functions represented in a variety of ways: graphical, numerical, analytical, or verbal-. They should understand the connections among these representations.
- understand the meaning of the derivative in terms of a rate of change and local linear approximation, and should be able to use derivatives to solve a variety of problems.
- understand 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 solve a variety of problems.
- understand the relationship between the derivative and the definite integral as expressed in

both parts of the Fundamental Theorem of Calculus.

- communicate mathematics and explain solutions to problems both verbally and in written sentences.
- model a written description of a physical situation with a function, a differential equation, or an integral.
- use technology to help solve problems, experiment, interpret results, and support conclusions.
- determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
- Students should develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

<The College Board, 2012 Goals for BC Calculus>

Overview of AP Calculus AB

- AP Calculus AB is roughly equivalent to a first semester college calculus course devoted to topics in differential and integral calculus. The AP course covers topics in these areas, including concepts and skills of limits, derivatives, definite integrals, and the Fundamental Theorem of Calculus. The course teaches students to approach calculus concepts and problems when they are represented graphically, numerically, analytically, and verbally, and to make connections amongst these representations.
- Students learn how to use technology to help solve problems, experiment, interpret results, and support conclusions.

Topic Outline for the Teaching of AP Calculus AB/BC

I. Functions, Graphs, and Limits

- Analysis of Graphs
- Limits of Functions (including one-sided limits)
- Asymptotic and Unbounded Behavior
- Continuity as a Property of Functions

II. Derivatives

- Concept of the Derivative
- Derivative at a Point
- Derivative as a Function
- Second Derivatives
- Applications and Computation of Derivatives

III. Integrals

- Interpretations and Properties of Definite Integrals
- Applications of Integrals
- Fundamental Theorem of Calculus
- Techniques and Applications of Antidifferentiation
- Numerical Approximations to Definite Integrals

Evaluation Components:

1. **Problem "journal"** -20%
   You will need to keep a journal/notebook/packet to record your assigned work from the course. This will be used as evidence for informal and formative assessments in order to determine the next step in the course. You will be asked to share this electronically on a regular basis.

2. **Exam Simulations** – 40%
   You will need to have a solid conceptual understanding of the topics in Calculus AB. At regular intervals, you will be asked to complete (in a testing environment) AP Calculus exam questions (from both MC and Free Response sections).

3. **Modeling Quality Teaching** - 30%
   You will be creating lessons for each of the 3 major domains of a calculus course. These include: (1) Functions, Graphs, and Limits, (2) Differentiation, and (3) Integration. In addition to creating appropriate lessons, you will be asked to teach a portion of the lesson to the instructor (and possibly a few undergraduates).

4. **Lesson Portfolio** – 10%
   This assessment is intended to provide the student with resources for their teaching. Including the lessons you create in #3, the Lesson Portfolio will contain a lesson plan from every main section in AP Calculus AB. These include the subheadings in the Topic Outline previously listed. This portfolio will have at least 17 different lessons – they do not have to all be self-created, but you are expected to find quality lessons.

Final grades will be based strictly on a point system. The minimum percent (no rounding) to attain each letter grade will be as follows:
A (93%); A- (90%); B+ (87%); B (83%); B- (80%); C+ (77%); C (73%); C- (70%)

Required Materials:

- Any Calculus book approved as an AP Calculus text.
- Calculator: (graphing, TI-83/84 or equivalent)
- Computer access, specifically to The College Board.