 **AP CALCULUS AB SYLLABUS**

**2014 - 2015**

**Overview**

AP Calculus AB is offered on a year-long A/B schedule; that is, the class meets ninety minutes every other day. Enrollment in the course is open to all students; however, the majority of students come from the Honors level Pre-Calculus course. All calculus courses are taught using the College Board AP curriculum with item objectives being linked to state and district curriculum guidelines and taking the AP Examination is part of the course requirement for each student. As stated in materials from the College Board, “the focus of the course is neither manipulation nor memorization of an extensive taxonomy of functions… [this] is not the core of these courses” (apcentral.collegeboard.com). The emphasis throughout is on understanding the *meaning* and *relationships* between main ideas such as derivatives, limits and integrals. For each main idea, students will be able to work with a variety of functions graphically, numerically, analytically, and verbally. The course divides naturally into four parts: review of functions, limits and derivatives, integration, and review.

**Review of functions**. When reviewing functions particular attention is given to novel approaches and organization. Special emphasis is put on the transformation of families of functions as well as their composition and decomposition. All discussions incorporate multiple representations (graphical, numerical, analytical, and verbal). Non-explicit functions, such as data sets, are explored. During this section, graphing calculator skills are developed and strengthened. A series of short labs are performed which serve to review calculator capabilities (such as regression analysis) and also as anticipatory sets (such as max/mins). In subsequent topics, graphing calculators become an integral part of the presentation process. Whether checking for reasonableness of answers, global perspectives, or subtle concepts such as local linearity, graphing calculators flesh out each investigation.

**Limits and the derivative.** Limits are approached initially from data, then, graphically and analytically. Limits to infinity are related to asymptotic behavior of graphs of functions. Students are responsible for a multi-representational “limit” project, which combines the solving of limits with a review of functions, all culminating in the intuitive introduction of the limit of the difference quotient. Continuity, *Intermediate Value Theorem*, *Extreme Value Theorem, and Mean Value Theorem* are discussed informally and formally. Derivatives are seen as natural results of limits and are interpreted as instantaneous rates of change and linear approximations before technique is emphasized. Use of the four representations is continued in this section. Applications such as related rates, max-min problems, rectilinear motion, and curve sketching are covered with the focus throughout on the derivative as a rate of change. Discussion of the limitations of graphing devices acts as reinforcement of the concepts.

**Integration.** Some review of summation notation and its use is required. The definite integral is developed as the limit of Riemann sums then related to area under curves and the antiderivative. Properties of definite integrals are studied as well as the relationship between integrals and derivatives, the *Fundamental Theorem of Calculus*. Transcendental functions are re-introduced and reviewed along with their derivatives. Applications of integrals discussed are area, volumes of plane regions, separable differential equations (including laws of growth and decay), numerical integration, and accelerated motion. Basic techniques of integration are explored. Graphing calculators and other CAI are particularly valuable for the visualization of these concepts.

**Review**. In addition to a linear review of each topic, students are presented with multi-step, multi-concept problems. Confidence in approaching these and other novel questions is emphasized. In particular, both the derivative and antiderivative of a function is discussed and applied. Technique is heavily drilled as well as some formula memorization. Previous AP Exam free response questions are practiced and discussed. After the AP Examination, additional topics such as L’Hopitals rule, volumes by shell method, and other concepts will be discussed as time permits.

![MM900283542[1]]()**Style and format of presentation**. With this amount of material to cover lecturing is hard to avoid. However, nearly every lecture involves give and take, questioning, and periods of discovery and experimentation. Opportunities to extend the concept based on student response are not limited by the curriculum. During each major topic students work in groups (both formally and informally) in order to practice formulating and explaining mathematical ideas to others. Every quarter a project is selected by each student which makes clear the value of calculus to the real world as well as giving them an opportunity to expand, in writing, some of their own ideas and extrapolations. These projects and expanded problems are often shared system wide. Some common project topics are: Optimizing the size and number of fire breaks in a forest, estimating areas and volumes of ponds, logistic growth involving carrying capacity.

AIMS

 The aims of this mathematics course is to enable students to:

1. Understand the meaning of the derivative in terms of rate of change and local linear approximations.
2. Work with functions represented graphically, numerically, analytically, or verbally and should understand the connections among these representations.
3. Understand the meaning of the definite integral both as a limit of Riemann sums and as a net accumulation of a rate of change, and understand the relationship between the derivative and integral.
4. Students should be able to model problem situations with functions, differential equations, or integrals and communicate both orally and in written form.
5. Develop logical, critical and creative thinking as well as patience and persistence in problem-solving
6. Employ and refine their powers of abstraction and generalization
7. Apply and transfer skills to alternative situations, to other areas of knowledge and to future developments.
8. Learn to appreciate the beauty of mathematics!!

**COURSE OUTLINE**

I. Review of Prerequisite Topics (**3 weeks**)

A. Linear models

B. Graphs

C. Functions

1. Polynomial

2. Exponential

3. Logarithmic

4. Inverse functions

5. Piecewise functions

6. Transformations and compositions of functions

II. Limits, Continuity, and Derivatives (**10 week)**

1. Limits
	1. Intuitive understanding of limits
		1. Numerical
		2. Graphical
	2. Analytical interpretations
		1. Laws of Limits
		2. Limits at Infinity
		3. One-sided limits
2. Continuity
	1. Intuitive understanding of continuity
		1. Continuity at a point
		2. Continuous functions
	2. Limits and Continuity
		1. Definition of Continuity
		2. Discontinuity
	3. Geometric understanding
		1. Intermediate Value Theorem
		2. Extreme Value Theorem
3. Derivatives
	1. Intuitive understanding of the derivative
		1. Numerical
		2. Graphical
	2. Definition of the derivative
	3. Derivative at a Point
		1. Average slope
		2. Instantaneous slope
		3. Tangent lines
		4. Approximate rates of change
	4. Derivative as a Function
		1. Basic Differentiation Rules
		2. Product, Quotient and Power Rules
		3. Chain Rule
		4. Implicit Differentiation
		5. Higher-order Derivatives
	5. Key Relationships
		1. Continuity and Differentiability
		2. Rolle’s Theorem & Mean Value Theorem
		3. First Derivative Test
		4. Second Derivative Test
	6. Applications of Derivatives
		1. Curve Sketching
			1. signs of f’ and f”
			2. concavity
			3. points of inflection
		2. Related Rates
		3. Optimization (max-min problems)
		4. Velocity & Acceleration
		5. Slope Fields
4. Integrals (**8 weeks**)
	1. Antiderivatives
	2. Riemann Sums
	3. Area Under a Curve
	4. Fundamental Theorem of Calculus

E. Techniques of Integration

1. Integration by substitution

2. Numerical integration

 a. Left & Right rectangles

 b. Trapezoidal Rule

 F. Applications of Integrals

 1. Areas of Plane Regions

 2. Volumes of Solids (with known cross-sections)

 3. Average value of a function

 4. Accelerated Motion

 5. Separable Differential Equations (done after IV.)

1. ![MP900439480[1]]()Transcendental Functions (**3 weeks**)
	1. Derivatives and Integrals of Logarithms
	2. Derivatives and Integrals of Exponential functions
	3. Derivatives and Integrals of Trig/inverse Trig functions
	4. Applications of Derivatives and Integrals using above functions

CLASSROOM PROCEDURES:

**Notebook Requirements:** Students will be required to keep a notebook that includes sections for **objective / warm-ups, notes, class work, homework, and progress monitoring.** *The progress monitoring section will hold the progress monitoring sheet, quizzes, assessments and tracking details for successful completion of the course.* A final notebook check will be held at the close of the course to check all work completed in the course as well as periodic checks (about every 2 weeks) throughout the course. Notebook checks are test grades.

**Assessments / Differentiated Education:** Students enrolled in the course will receive daily differentiated assignments, assignments that require higher order thinking skills, multi-step problem solving, real life application skills, regular quizzes, unit assessments and a midterm exam. Furthermore, AP Calc students are expected to take the AP Calc exam or a teacher – made final exam.

**Classroom Expectations:** Students are expected to arrive to class each school day with notebook / paper, **Calculus book**, graphing calculator, pencil and any assignments that are due for that day. **The student will quietly enter the room, sharpen pencil, be seated, and immediately begin work on the objective / warm-up before the bell rings.** The student is expected to stay attentive during the entire class period, complete all assignments, be on the right page, working hard, answering questions when called upon, and turning in work as requested. Students are not expected to talk to other students unless it is a group work or peer tutoring**. “Social talk” that is not about the class subject matter is not permitted in this class.** Trash is to be thrown away at class dismissal. Students are to ask to sharpen their pencils during class / lecture time. Students do not answer the door unless directed by the teacher. In short, students should remain seated until the class dismissal unless directed to move about the classroom by the teacher and quiet unless given permission to talk by the teacher.

**Classroom Rules:**

* Be prepared for class daily – active and ready to learn.
* Respect others at all times and accept responsibility for your own actions. (Absolutely no negative comments to others at any time!!)
* **Remain quiet and attentive during all announcements which includes the television or the intercom.**
* Callouts are generally not allowed, raise hand and wait to be recognized by the teacher before speaking.
* No talking during a test session. A test session is defined as the moment the first test is on a student’s desk. **Talking is talking of any sort. This will result in a zero test grade and phone call placed to a parent.**
* **Absolutely no texting or use of cell phone in this class unless designated by the teacher as part of the instructional work for the day!**
* Raise your hand and wait to be recognized before speaking in this class.
* ![MP900439390[1]]()All other rules in the CMS Rights and Responsibilities Handbook for Secondary School or outlined in general North Mecklenburg High School procedure.

**Grading Percentages:**

Formal Assessments / Objective Mastery Tests– 70%

Informal Assessments – 30% (Informal assessments include quizzes,

class work and homework.)

Normal Calculations will be used for Semester and Final Grades. *A* ***retake session*** *will be held every Friday morning from 6:30am to 6:50a.m. as well as Friday afternoon from 2:30 – 3:15.* Students will at that time retake tests or quizzes to indicate 80% mastery of objectives. Always read the announcements posted on the board in the room as well any school wikispaces.

**Makeup Work:** Makeup work is **absolutely** due two weeks upon first day return to school. Makeup work is posted in the makeup work notebook on the table in our room. Assignments should be copied from the book, dated correctly, completed and turned into the teacher. *Now* ***makeup sessions*** *are* ***every*** *Friday morning at 6:30am.* Students may during that time **makeup missed tests or quizzes**, turn in makeup work or receive progress report on grade status. However, during the last two weeks of the quarter, makeup work must be completed within 3 to 5 days of the day missed.

**Tutoring:** The teacher tutoring for this course occurs on Thursday afternoons except from 2:30 – 3:15. However, this is not a time to makeup tests or quizzes. It is set aside for helping students. Longer, concentrated tutorial sessions will be announced and held in preparation for the midterm and final assessments as well as project completion.

**Grade Updates:** A student may make an after school appointment with the teacher to discuss grades, receive progress report or suggestions for improvement on grades. **Individual student grades will never be discussed with a student during class time.**

![MP900448273[1]]()**Concerns, Suggestions or Questions**: Please contact the teacher via e-mail (sarnya.ervin) or school phone for a prompt answer or discussion.

**Additional Requirement:** EXCELLENCE!!!

Mrs. Ervin, Mathematics Instructor

**REFERENCES AND MATERIALS**

**Textbook**:

Finney, Demana, Waits, Kennedy. *Calculus—Graphical, Numerical, Algebraic*. Upper Saddle River:Pearson/Prentice Hall. 2010.

**References**:

Larson, Hostetler, Edwards. *Calculus of a Single Variable.* 7ed. Boston: Houghton Mifflin Co., 2002.

Hughes-Hallett, Gleason, McCallum et al. *Calculus*. 3rd Ed. Hoboken, NJ: Wiley. 2002.

Cohen, Gaughan, Knoebel, Kurtz, Pengelley. *Student Research Projects in Calculus*. MAA. 1991

International Baccalaureate Organization Mathematics SL Diploma Programme Manual

**Graphing Calculators**: TI-83 plus / 84/ 89