MATHEMATICS COURSE SYLLABUS

Course Title: Calculus I - H2

Department: Mathematics

Primary Course Materials:

Applied Calculus - Third Edition, Wiley & Sons Publisher
TI-84 Graphing calculator
Teacher designed materials to supplement the textbook

Course Description:

Calculus I - H2 is a problem driven course. Practical, real world problems considered from a geometrical, numerical and algebraic point of view guide this course. In this context students study differential calculus and integral calculus. Calculators, data collection devices, computers and other current technology are used on a regular basis in this class, on projects and in laboratory expereiences, helping students to think mathematically and to connect their learning to the real world. A practical understanding of the integral, the idea of "going backwards" from the derivative to the original function will be developed followed by an emphasis on numerical integration as well as integration techniques. Practical skills as well as a theoretical understanding will be stressed.

Essential Questions:

1. How does calculus help us understand and analyze more deeply the local and global behavior of functions?
2. How does the study of calculus allow us to quantify the study of the rate of change of functions in a variety of applications such as geometry, the sciences, probability, business, economics, etc.
3. How do you recover/calculate the total change of a function given its rate of change?
4. How does technology allow students to deepen their understanding of mathematics?

Course Objectives:

Common Goals:

Thinking and Communicating

1) ☒ Read information critically to develop understanding of concepts, topics and issues.
2) ☒ Write clearly, factually, persuasively and creatively in Standard English.
3) ☒ Speak clearly, factually, persuasively and creatively in Standard English.
4) ☒ Use computers and other technologies to obtain, organize and communicate information and to solve problems.
5) ☒ Conduct research to interpret issues or solve complex problems using a variety of data and information sources.

Gain and Apply Knowledge in and across the Disciplines

6) Gain and Apply Knowledge in:
   a) ☐ Literature and Language
   b) ☒ Mathematics
   c) ☒ Science and Technology
   d) ☐ Social Studies, History and Geography
   e) ☐ Visual and Performing Arts
   f) ☐ Health and Physical Education

Work and Contribute

7) ☐ Demonstrate personal responsibility for planning one's future academic and career options.
8) ☐ Participate in a school or community service activity.

9) ☐ Develop informed opinions about current economic, environmental, political and social issues affecting Massachusetts, the United States and the world and understand how citizens can participate in the political and legal system to affect improvements in these areas.

Learning Standards from the Massachusetts Curriculum Framework:

A chart is attached identifying which of the standards from the Massachusetts Curriculum Frameworks will e assessed in this course.

Additional Learning Objectives Beyond the Curriculum Framework:

21st Century Skills:

Instructional practices support the achievement of 21st C. Learning Expectations by:

____x_ personalizing instruction
____x_ engaging students in cross disciplinary learning
____x_ engaging students as active and self directed learners
_ __x_ emphasizing inquiry, problem solving and higher order thinking
____x_ applying knowledge and skills in authentic tasks
__ _x_ engaging students in self assessment and reflection
___x_ integrating technology

Content Outline:

1. **Functions**
   - **Analysis of graphs**
   - **Limits of functions**
   - **Asymptotic and unbounded behavior**
   - **Continuity as a property of functions**

2. **Derivatives**
   - **Concept of the derivative as rate of change**
   - **Derivative at a point**
   - **Derivative as a function**
   - **Second derivative and concavity**
   - **Computation of derivatives**
   - **Applications of derivatives**

3, **Integrals**
   - **Reimann sums and the definite integral**
   - **Interpretation and properties of the definite integral**
   - **Techniques of anti-differentiation**
   - **First and Second Fundamental Theorems of Calculus**
   - **Applications of integrals**

Major Evaluation Strategies:

Name of Assessment	Type of Assessment		Common Goals Assessed	Standards Assessed	Other Objectives Assessed
	Test	Performance Assessment			
Quizzes	☒	☐			
Tests	☒	☐			
Homework	☐	☐			
Common assessments	☐	☒			
Projects	☐	☐			
Class participation	☐	☐			

High School Content Standards

Conceptual Category: Number and Quantity

Conceptual Category: Algebra

A-SSE Seeing Structure in Expressions

Write expressions in equivalent forms to solve problems.

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
   a. Factor a quadratic expression to reveal the zeros of the function it defines.
   b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
   c. Use the properties of exponents to transform expressions for exponential functions. *For example, the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*

A-CED Creating Equations

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.⋆
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. ⋆
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling

⋆ indicates Modeling standard.
(+) indicates standard beyond College and Career Ready.

	context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* ⋆ 4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.* ⋆
	Conceptual Category: Functions
F-IF	Interpret functions that arise in applications in terms of the context. 4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* ⋆ 5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* ⋆ 6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. ⋆ Analyze functions using different representations. 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ⋆ a. Graph linear and quadratic functions and show intercepts, maxima, and minima. ⋆ c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. ⋆ d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. ⋆ e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. ⋆ 8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
F-LE	Linear, Quadratic, and Exponential Models Construct and compare linear, quadratic, and exponential models and solve problems.

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	3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. ⋆ Interpret expressions for functions in terms of the situation they model. 5. Interpret the parameters in a linear or exponential function in terms of a context. ⋆
	Conceptual Category: Statistics & Probability
S-ID	Interpret linear models. 7.Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. ⋆
	MODEL ADVANCED COURSE: Model Precalculus
F-IF	Interpreting Functions Analyze functions using different representations. 7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ⋆ d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. ★
F-BF	Building Functions Build a function that models a relationship between two quantities. 1. Write a function that describes a relationship between two quantities. ⋆ c. (+) Compose functions. *For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time.* ★ Build new functions from existing functions.

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