The mission of Hermon High School is to prepare students for personal success in college, career, and community.

## Calculus

Instructor(s):
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This course is designed to give students approximately one semester of college Calculus. An understanding of limits, trigonometry and functions is necessary. An in-depth study of limits, derivatives, integrals and the applications of each will be the focus of the course. The course may be taken for dual credit (high school and college credit) through USM's ASPIRE program. Tuition for USM credit is free per the Maine DOE Aspirations program.

1 HHS credit, 4 credit hours USM
Graduation Standards: (the number of the standard is referenced in the performance indicators listed in each unit.)
HS.M.1A Applies properties of real numbers and quantitative reasoning.
HS.M.2.A Solves polynomial, rational, radical, and transcendental equations \& systems of equations.
HS.M.2B Understands and analyzes polynomial, rational, radical, and transcendental functions.
HS.M.5.A Computes, analyzes, and interprets derivatives. (STEM)

| Unit 1 | Precalculus Review \& Limits |
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| Summary | In this unit students will review the concepts of precalculus which are most <br> important to early success in calculus. Topics will include linear and nonlinear <br> functions, their graphs, roots, and important features. Concepts of limits will be <br> covered in detail as limits are what distinguish calculus from algebra. Students will <br> understand the concept of a limit, be able to find limits through graphical, numerical, <br> and algebraic techniques and explain why some limits do not exist. Limits will be <br> used to determine continuity. |
| Performance <br> Indicators <br> Assessed <br> in Unit | AR.A.1 Interpret the structure of expressions. <br> AR.A.11 Represent and solve equations and inequalities graphically. <br> AR.A.13 Interpret functions that arise in applications in terms of the context. $\star$ <br> AR.A.14 Analyze functions using different representations. <br> AR.A.19 Extend the domain of trigonometric functions using the unit circle. <br> Supporting |
| QR.A.3 Reason quantitatively and use units to solve problems. |  |


| - How to calculate limits |  | - Graph, solve, and manipulate exponential functions <br> - Analyze a function and use properties of logarithms <br> - Determine the properties of trigonometric functions <br> - Calculate limits by using their properties <br> - Determine if a function is continuous and identify types of discontinuity <br> - Find equations for tangent and normal lines to curves | - Reason abstractly and quantitatively <br> - Look for and make use of structure <br> - Look for and express regularity in repeated reasoning |
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| Unit 2 | Derivatives \& Applications |  |  |
| Summary | Concepts of derivatives will be covered in detail. The unit begins with using the definition of a derivative to find instantaneous rates of change. This is followed with a discussion of what it means for a function to be differentiable. Students then learn rules for differentiation and go on to find velocity and other rates of change. Derivatives of trigonometric, logarithmic, exponential and inverse trigonometric functions are learned and applied. Students learn to take derivatives of composite functions through the use of the chain rule and implicit functions through implicit differentiation. |  |  |
| Performance Indicators Assessed in Unit | AR.A. 1 Interpret the structure of expressions. <br> AR.A. 2 Write expressions in equivalent forms to reveal information and to solve problems. <br> AR.A. 8 Understand solving equations as a process of reasoning and explain the reasoning. <br> AR.A. 15 Build a function that models a relationship between two quantities. AR.A. $20(+)$ Model periodic phenomena with trigonometric functions. <br> Supporting <br> QR.A. 1 Extend the properties of exponents to rational exponents. <br> QR.A. 3 Reason quantitatively and use units to solve problems. |  |  |
| Understandings: |  | Students will know... | Students will be able to... |


| - The derivative is an average rate of change over an interval which goes to zero. <br> - Rates of change are not constant. <br> - Derivative rules simplify the differentiation process. <br> - How to take the derivative of any function and what that means in the given context |  | - Derivative Definition <br> - Derivative Notation <br> - How to apply the Power rule, Product rule, Quotient rule, and Chain rule. <br> - How to find higher order derivatives | - Make sense of problems and persevere in solving them <br> - Reason abstractly and quantitatively <br> - Model with mathematics <br> - Look for and make use of structure |
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| Unit 3 Applications of Derivatives |  |  |  |
| Summary | Concepts of have been lea concavity, an Theorem. M problems and | tives will be covered in detail. N students begin using the deriva raph functions. Students learn a g and optimization are emphasiz d rate problems. | that all derivative techniques to determine extrema, apply the Mean Value as students solve $\min / \max$ |
| Performance Indicators Assessed in Unit | AR.A. 1 Interp AR.A. 2 Write problems. AR.A. 7 Create <br> AR.A. 14 Anal AR.A. 16 Build Supporting QR.A. 1 Exten AR.A. 10 Solv AR.A. 15 Build | the structure of expressions. pressions in equivalent forms to $r$ <br> quations and/or inequalities that descer <br> e functions using different represe ew functions from existing functi <br> he properties of exponents to ratio ystems of equations. <br> function that models a relationsh | eal information and to solve cribe numbers or relationships. tations. s. al exponents. between two quantities. |
| Understandings: |  | Students will know... | Students will be able to... |
| - Derivatives can be used to maximize or minimize given values. <br> - Extreme values and concavity give information about the rate of change. <br> - Derivatives can be taken even when the function involves multiple variables. |  | - The Extreme Value Theorem <br> - The Mean Value Theorem <br> - How to apply the first and second derivative tests <br> - How to solve optimization and related rates problems | - Make sense of problems and persevere in solving them <br> - Model with mathematics <br> - Look for and make use of structure <br> - Look for and express regularity in repeated reasoning |


| Unit 4 | Integrals \& Applications |  |  |
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| Summary | We begin our study of 'accumulation' through estimating with finite sums and define the definite integral as a limit of Riemann sums. We extend our knowledge of integration to antiderivatives and use the Fundamental Theorem of Calculus to connect derivatives with integrals. When given numerical data, we use trapezoidal approximations to find accurate estimates of integrals. |  |  |
| Performance Indicators Assessed in Unit | AR.A. 1 Interpret the structure of expressions. <br> AR.A. 2 Write expressions in equivalent forms to reveal information and to solve problems. <br> AR.A. 8 Understand solving equations as a process of reasoning and explain the reasoning. <br> AR.A. 14 Analyze functions using different representations. <br> Supporting <br> QR.A. 1 Extend the properties of exponents to rational exponents. <br> QR.A. 3 Reason quantitatively and use units to solve problems. |  |  |
| Understandings: |  | Students will know... | Students will be able to... |
| - An integral is curve or set of <br> - Integration rul integration pro <br> - How to take th function and w the given context. | e area under a curves. simplify the ess. integral of a hat that means in t. | - How to apply the RAM <br> - How to calculate definite integrals <br> - Integral Notation <br> - Rules for definite integrals <br> - The fundamental theorem of calculus | - Make sense of problems and persevere in solving them <br> - Reason abstractly and quantitatively <br> - Model with mathematics <br> - Use appropriate tools strategically <br> - Look for and express regularity in repeated reasoning |
| Unit 5 | Applications of Integrals |  |  |
| Summary | We will explore methods of rebuilding from derivatives to original functions by using slope fields. We perform algebraic integrations using substitution, partial fractions, and integration by parts. Once students have a solid understanding of how to find an integral and what the integral represents, we begin using the integral to calculate accumulations of rates, area under a curve and area between two curves. We learn techniques for finding volumes for solids of rotation and volumes for solids of known cross-sections and do some basic problem solving pertaining to three dimensional objects. |  |  |


| Performance Indicators Assessed problems. in Unit AR.A. 7 Create <br> AR.A. 14 Analy AR.A. 16 Build Supporting QR.A. 1 Extend QR.A. 3 Reason | AR.A. 2 Write expressions in equivalent forms to reveal information and to solve problems. <br> AR.A. 7 Create equations and/or inequalities that describe numbers or relationships. <br> AR.A. 14 Analyze functions using different representations. <br> AR.A. 16 Build new functions from existing functions. <br> Supporting <br> QR.A. 1 Extend the properties of exponents to rational exponents. <br> QR.A. 3 Reason quantitatively and use units to solve problems. |  |
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| Understandings: | Students will know... | Students will be able to... |
| - Different functions require different integration methods. <br> - Though different methods are used, an integral is calculating the cumulative area under a given curve or curves. <br> - Integrals can be applied to higher dimensions to not only calculate area, but volume as well. | - How to construct slope fields <br> - Properties of indefinite integrals <br> - The process of u-substitution <br> - The process of integration by parts <br> - How to take the integral of any function and what that means in the given context | - Make sense of problems and persevere in solving them <br> - Reason abstractly and quantitatively <br> - Model with mathematics <br> - Look for and make use of structure <br> - Look for and express regularity in repeated reasoning |

## Summative Assessments/Retake

- Summative assessments will count as $70 \%$ of the grade.
- Students have the opportunity to retake summative assessments.
- The student must submit a retake form to the teacher within five (5) school days of the date that the summative assessment score is reported to the student.
- The highest score a student can receive on a retake or late assessment is a 75.
- The score achieved on a retake will replace the current score (even if the score is lower).
- If a student is making up a test from an absence, that assessment will be graded up to 100 .


## Make-up Work

Upon their return to school from an absence, it is the student's responsibility to secure make-up work from their teacher. The due date of the missed work will be one additional class period for each day of absence from that class or at the discretion of the teacher.

## Grading of Formative Assessments

- Formative assessments will count as $30 \%$ of the grade.
- Formative assessments may be scored on either a 0-100 scale or a 0-4 scale.
- The 0-4 scale will be represented in Power School as $4=100,3=87,2=77$, and $1=67$.
- The method of scoring of formative assessments will be determined by assignment.


## Finals / Midterms

An end of course Final Exam will be conducted, making up $10 \%$ of the students overall grade.

