NATIONAL UNIVERSITY VIRTUAL HIGH SCHOOL
AN AFFILIATE OF THE NATIONAL UNIVERSITY SYSTEM

Course Syllabus

Introduction

Calculus is a mathematics course designed to provide the student with the prerequisite skills necessary for calculus B and the advanced placement exam. A strong background in algebra 2, trigonometry, and Precalculus is necessary in order to be successful in this course. The major topics explored in this course include limits, derivatives and applications of differentiation. Additionally, this course addresses three learning styles (visual, auditory, and kinesthetic) through projects, discussions, online interactivities, as well as traditional coursework.

Major Learning Targets

Concepts and Procedures: Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency

Problem Solving: Students can frame and solve a range of complex problems in pure and applied mathematics

Communication and Reasoning: Students can clearly and precisely construct viable arguments to support their own reasoning and critique the reasoning of others

Data Analysis and Modeling: Students can analyze complex, real-world scenarios and can use mathematical models to interpret and solve problems.

Learning Outcomes

At the completion of Calculus A, the student will be able to

1. Determine and evaluate limits graphically, numerically, and analytically.
2. Determine continuity at a point and over a specified interval.
3. Evaluate limits at infinity.
4. Understand the relationship between the tangent line and the derivative.
5. Know and apply the definition of a derivative
6. Know and apply rules for differentiation
7. Perform implicit differentiation.
8. Do related rates problems
9. determine extreme values on an interval
10. Apply Rolle's Theorem and the Mean Value Theorem
11. Apply the first derivative test to increasing and decreasing functions
12. Apply the second derivative test to concavity
13. Apply first and second derivatives to curve sketching
14. Problem solve relating to optimization
15. Know and apply Newton 's Method
16. Find the differential of a function

Course Materials

The following is required of all Calculus students:

- Textbook: CALCULUS 7th edition by Larson, Hostetler, and Edwards.
- Barron's AP Calculus Advanced Placement Examination: Review of Calculus AB and Calculus BC 6th edition, by Hockett

- Graphing Calculator: A TI-83 Plus or TI-84. Check with your instructor for other options.

Other Items: Access to a computer with internet access, regular and graph paper, pencils and a notebook for hardcopy organization.

USING EQUATION EDITOR

Equation Editor, available on Microsoft Word, allows students and teachers to write mathematical expressions and equations directly onto a Word document. This option is especially useful with online math courses because it is easy to use with Blackboard and email. The following instructions will help to make Equation Editor accessible on your toolbar.

Begin by opening a blank Word document. Go to View, then to Toolbars, then to Customize. Under “categories”, click on Insert. Under “commands”, find Equation Editor. Drag Equation Editor up to your toolbar (anywhere on the toolbar will be fine). The button on your toolbar will look like a square root symbol.

You should practice using Equation Editor on a blank Word document until you can use it comfortably.

TO PARENTS

Parents are encouraged to follow student progress and to be proactive in their child's learning, wherever possible. Parents can check through the online course to monitor student progress and check grades. Parents will be contacted throughout the course to update student progress. Parents are also encouraged to communicate with the instructor should any questions or concerns arise.

WHAT DOES IT TAKE TO BE SUCCESSFUL IN THIS COURSE?

Being proactive about your progress and learning in this course is your key to success! You are the one who needs to be in charge of your learning. Successful students will do all the following:

- Do the required reading.
- Carefully read and retry the examples/exercises from the text.
- Visit all teacher recommended websites and do all of the activities suggested in the topic lectures for each week.
- Ask questions wherever possible. Be assertive about your learning!
- Be involved with online chats and discussions.
- Submit all assignments, projects, and tests on time.
- Pace yourself! Budget and plan your time carefully.
- Start your projects when suggested.

Course Outline

Course Outline - Calculus A:

The following is an overview of Calculus A course content. Students are encouraged to print this document for reference and pacing throughout the course.

Week One:

Learning Outcomes

At the end of week one, students will be able to:

- Differentiate between calculus and precalculus
- Understand the tangent line and how it applies to calculus
- Understand the area problem and how it applies to calculus
- Estimate a limit visually or numerically
- Determine if a limit fails to exist
- Apply the formal definition of a limit
- Apply the properties of limits
- Apply dividing out and rationalizing techniques when evaluating limit
- Apply the Squeeze Theorem

Required Reading
The following is required reading for the first week.

Section	Title	Pages
1.1	A Preview of Calculus	42
1.2	Finding Limits Graphically and Numerically	48
1.3	Evaluating Limits Analytically	57

Topic Lectures
For week one, students access a set of teacher recommended sites containing formal definitions, examples and tutorials.

Assignments
 Exercises from the book (see "week one exercises" for a detailed list)

Live Learning and Chat Sessions
Students are required to attend one live session per week (5 points each). Bring any questions or comments.

Discussion Board
Answer two of the following:

1. Introduce yourself. Why are you taking an online course?
2. What is the slope of a vertical line? What is the slope of a horizontal line?
3. Why is division by zero not defined in mathematics? Give an example.
4. Give the equation of a parabola that has x-intercepts -2 and 0. What is the vertex?
5. How many integers are between 1 and 10? How many real numbers are between 1 and 10?

Test
Learning Outcomes Assessment

Standards Addressed
Referring to the syllabus, the following NCTM Standards are addressed during week one: 1, 2, 4, 9. The following California State Board of Education Standards are addressed during week one: 1.1

Week Two:

Learning Outcomes
At the end of week one, students will be able to:

- Determine point and interval continuities
- Determine one sided limits and continuity
- Apply the properties of continuity

- Understand and use the Intermediate Value Theorem
- Determine left and right infinite limits
- Use limits in determining vertical asymptotes
- Find the slope of the tangent line at a point
- Apply the definition of a derivative
- Know the difference between differentiability and continuity

Required Reading
The following is required reading for the second week.

Section	Title	Pages
1.4	Continuity and One-sided Limits	68
1.5	Infinite Limits	80
2.1	The Derivative and the Tangent Line Problem	94

Topic Lectures
For week two, students access a set of teacher recommended sites containing formal definitions, examples and tutorials.

Assignments
- Exercises from the textbook (see "Week Two Assignments")
- Consider project options; decide on which project you would like to begin.

Live Learning and Chat Sessions
Students are required to attend one live session per week (5 points each). Bring any questions or comments.

Discussion Board
Answer two of the following:

1. True or False: If an apple falls from a tree, its velocity remains constant until it hits the ground?
2. Give an example of a function whose limit at x = 2 is equal to 1. Give an example of another function whose limit at x = 2 does not exist.
3. True or false: If a certain function f(x) is continuous everywhere, then f(a) is a real number, for any real number a.
4. Give an example of a function f(x) that is continuous everywhere except at x = 0.

Test
Week Two Test

Standards Addressed
Referring to the syllabus, the following NCTM Standards are addressed during week two: 1, 2, 3, 8, 9.
The following California State Board of Education Standards are addressed during week two: 2.0, 3.0

Week Three:

Learning Outcomes
At the end of week one, students will be able to:

- Find the derivative of a function using the Constant Rule, the Power Rule, the Constant Multiple Rule, and the Sum and Difference rule
- Find the derivative of Sine and Cosine functions
- Determine rates of change using derivatives
- Find the derivative of a function using the Product and Quotient Rules
- Find the Derivative of a trigonometric Function
- Find the derivative of a composite function and a trigonometric function using the Chain Rule
- Find the derivative of a function using the General Power Rule

Required Reading
The following is required reading for the third week.

Section	Title	Pages
2.2	Basic Differentiation Rules and Rates of Change	105
2.3	The Product and Quotient Rules and Higher Order Derivatives	117
2.4	The Chain Rule	127

Topic Lectures
For week three, students access a set of teacher recommended sites containing formal definitions, examples and tutorials.

Assignments
- Exercises from the textbook (see “Week Three Assignments”)
- Work on projects

Live Learning and Chat Sessions
Students are required to attend one live session per week (5 points each). Bring any questions or comments.

Discussion Board
Answer two of the following:

1. True or False: It is possible for two different functions to have the same derivative.

2. Give an example of a function whose first, second, and third derivatives are all equal.
3. If g(x) = sin(ax), find the value of a so that g'(x) = -2x cos(2x).

Test
Week Three Test

Standards Addressed
Referring to the syllabus, the following NCTM Standards are addressed during week three: 1, 2. The following California State Board of Education Standards are addressed during week three: 4.0, 5.0, 7.0

Week Four:

Learning Outcomes
At the end of week four, students will be able to:

- Understand the difference between an implicit and explicit function
- Apply implicit differentiation
- Find a related rate and apply related rates to real life situations
- Understand the concept of extrema on an interval
- Find extrema on a closed interval

Required Reading

The following is required reading for the fourth week.

Section	Title	Pages
2.5	Implicit Differentiation	137
2.6	Related Rates	144
3.1	Extrema on an Interval	160

Topic Lectures
For week four, students access a set of teacher recommended sites containing formal definitions, examples and tutorials.

Assignments
- Exercises from the textbook (see “Week Four Assignments”)
- Work on projects

Live Learning and Chat Sessions
Students are required to attend one live session per week (5 points each). Bring any questions or comments.

Discussion Board
Answer two of the following:

1. Make up a function in implicit form. Find the derivative with respect to x using two different methods. Show that your answers are the same.
2. Consider the equation xy = 3. Use implicit differentiation by taking the derivative of both sides of the equation with respect to y. How can you find dy/dx using this result?
3. Can you think of a function where it is easier to find dy/dx using implicit differentiation instead of solving for y and finding dy/dx in the usual fashion?
4. Do problem #52 on page 152. Show your work and explain your reasoning.
5. Is the following statement always true, sometimes true, or never true? *Suppose a function f(x) is continuous on an open interval (a, b). If a < c < b, then f(a) < f(c) < f(b)* . Explain.

Test
Week Four Test

Standards Addressed
Referring to the syllabus, the following NCTM Standards are addressed during week four: 1, 2, 6, 9. The following California State Board of Education Standards are addressed during week four: 6.0, 12.0

Week Five:

Learning Outcomes
At the end of week five, students will be able to:

- Apply Rolle's Theorem and the Mean Value Theorem
- Determine intervals for which a function is increasing, decreasing, or constant
- Apply the first derivative test to find relative extrema
- Find the intervals on which a function is concave up or down
- Use second derivatives in finding inflection points for a function
- Apply the second derivative test in finding relative extrema of a function

Required Reading
The following is required reading for the fifth week.

Section	Title	Pages
3.2	Rolle's Theorem and the Mean Value Theorem	168
3.3	Increasing and Decreasing Functions and the First Derivative Test	174
3.4	Concavity and the 2 nd Derivative Test	184

Topic Lectures
For week five, students access a set of teacher recommended sites containing formal definitions, examples and tutorials.

Assignments
- Exercises from the textbook (see "Week Five Assignments")
- Work on projects

Live Learning and Chat Sessions
Students are required to attend one live session per week (5 points each). Bring any questions or comments.

Discussion Board
Answer two of the following:

1. How is calculus A going? What are my strengths and weaknesses in this class? How much time do I spend each day studying for this class, on average? What suggestions would I make to improve this class?
2. Is the following statement always true, sometimes true, or never true? *The function f(x), whose domain is all real numbers, is increasing if x < 0 and constant if x > 0. If a < b, then f(b) < f(a).* Explain.
3. Discuss the differences and similarities between Rolle's Theorem and the Mean Value Theorem.
4. Is the following statement always true, sometimes true, or never true? *Every third degree polynomial function has at least one inflection point.* Explain.
5. Give an example of a polynomial function whose domain is all real numbers, has one inflection point, one x-intercept, and is decreasing everywhere.

Test
Week Five Test

Standards Addressed
Referring to the syllabus, the following NCTM Standards are addressed during week five: 1, 2, 7, 8, 9. The following California State Board of Education Standards are addressed during week five: 8.0, 9.0

Week Six:

Learning Outcomes
At the end of week six, students will be able to:

- Determine limits at infinity
- Use limits in determining asymptotes
- Determine infinite limits at infinity
- Use derivatives to analyze and sketch graphs of functions

- Apply differentiation to optimization

Required Reading
The following is required reading for the sixth week.

Section	Title	Pages
3.5	Limits at Infinity	192
3.6	A Summary of Curve Sketching	202
3.7	Optimization Problems	211

Topic Lectures
For week six, students access a set of teacher recommended sites containing formal definitions, examples and tutorials.

Assignments
- Week Six Assignments
- Work on projects

Live Learning and Chat Sessions
Students are required to attend one live session per week (5 points each). Bring any questions or comments.

Discussion Board
Answer two of the following:

• Is the following statement always true, sometimes true, or never true? *If a rational function has exactly one vertical asymptote, then the limit as x goes to infinity is a finite real number.* Explain.

• Why is the limit as x goes to infinity of f(x) = sinx *not exist* ? Explain your reasoning.

• How can a calculator be helpful in finding limits at infinity? Give an example.

• Give three real life situations where mathematical optimization would apply.

• Do problem #60 on page 220. Give your answers and explain your reasoning.

Test
Week Six Test

Standards Addressed
Referring to the syllabus, the following NCTM Standards are addressed during week six: 1, 2, 4, 6, 9. The following California State Board of Education Standards are addressed during week six: 9.0, 11.0

Week Seven:

Learning Outcomes
At the end of week seven, students will be able to:

- Use Newton's Method in approximating zeros of a function
- Know and apply tangent line approximation
- Kwon what a differential is (dy) and compare it with the actual change in y
- Estimate a propagated error
- Find the differential of a function
- Give the solution for a differential equation
- Use indefinite integral notation
- Use integration rule to find anti-derivatives
- Apply L'Hopital's Rule

Required Reading
The following is required reading for the seventh week.

Section	Title
3.8	Newton's Method
3.9	Differentials
7.7	L'Hopital's Rule

Topic Lectures
For week seven, students also access a set of teacher recommended sites containing formal definitions, examples and tutorials.

Assignments
- Week seven assignments
- Work on projects

Live Learning and Chat Sessions
Students are required to attend one live session per week (5 points each). Bring any questions or comments.

Discussion Board
Answer two of the following:

1. What is Newton's Method, in your own words? Do you think it is important to learn Newton's Method in calculus?
2. Give an example of a sequence of numbers that converge? Give an example of a sequence of numbers that do not converge (diverge)

3. Historically, what mathematicians are credited with creating calculus? During what century did each live?
4. Is the following statement always true, sometimes true, or never true? *If y = x + c, then dy = dx.* Explain.
5. Find the inflection point(s), if any, for the function f(x) = x(x + 2)(x – 3).

Test
Week Seven Test

Standards Addressed
Referring to the syllabus, the following NCTM Standards are addressed during week seven: 1, 2, 4, 5, 6, 7, 8, 9. The following California State Board of Education Standards are addressed during week seven: 10.0, 11.0

Week Eight:

Learning Outcomes
At the end of week eight, students will be able to:

- Make connections between projects and learning outcomes for this course.
- Demonstrate knowledge of trigonometry sufficient for placement in higher mathematics.

Required Reading
Students are asked to review prior readings in preparation for the final exam.

Topic Lectures
For week eight, students access a set of teacher recommended sites containing formal definitions, examples and tutorials.

Assignments
- Review exercises
- Complete and turn in projects to the instructor.

Live Learning and Chat Sessions
Students are required to attend one live session per week (5 points each). Bring any questions or comments.

Test
Final Exam

Discussion Board
Answer two of the following:

1. What areas do I need to focus on the most in order to prepare for the final exam?

2. Have I completed and turned in my projects?
3. What formulas do I need to be familiar with before I take the final exam?
4. What math class am I taking next?
5. What did I get out of this course? How did taking this course help me the most?

Standards Addressed
Referring to the syllabus, the following NCTM Standards are addressed during week eight: 1, 2, 3, 4, 6, 7, 8, 9, 10. The following California State Board of Education Standards are addressed during week seven: 1.0 through 12.0

Assessment

Both formal and informal assessments methods will be employed. Informal assessment will include an evaluation of participation in weekly chats and discussions and grading rubrics for projects and assignments. Formal assessment will be employed for tests and the final examinations.

GRADING SCALE:
This course is worth a total of 850 points. Your final grade will be determined according to the following:

Letter Grade	Percentage Earned
A	95%+
A-	90% - 94.9%
B+	87% - 89.9%
B	84% - 86.9%
B-	80% - 83.9%
C+	77% - 79.9%
C	74% - 76.9%
C-	70% - 73.9%
D+	67% - 69.9%
D	64% - 66.9%
D -	60% - 63.9%
F	59% and lower

TIME MANAGEMENT:
Since this full semester course is completed in eight weeks, you should expect to spend 12-15 hours per week on the assignments, discussions, chats, tests, and projects. This course will cover chapters 1 – 3 from the text CALCULUS 7th edition, Larson, Hostetler, Edwards.

STANDARDS ADDRESSED:
Both National Council of Teachers of Mathematics (NCTM) and California State Board

of Education Mathematics Content Standards are addressed throughout this course.

A summary of NCTM standards are listed as follows. Detailed learning expectations for each of the following can be viewed on the NCTM website.

1. Number and Operations
2. Algebra
3. Geometry
4. Measurement
5. Data Analysis and Probability
6. Problem Solving
7. Reasoning and Proof
8. Communication
9. Representation

California State Board of Education Standards for Mathematics can be viewed at:
http://www.cde.ca.gov/be/st/ss/mthtrig.asp

NUVHS Expected Schoolwide Learning Results (ESLRs)

NUVHS Expected Schoolwide Learning Results (ESLRs):

It is anticipated that NUVHS students will be:

Engaged Learners

1. Demonstrate self-directed learning skills such as time management, and personal responsibility through the completion of course requirements
2. Develop an understanding of their own preferred learning styles to enhance their overall academic potential
3. Incorporate effective and relevant internet and multimedia resources in their learning process to broaden their knowledge base

Critical Thinkers

1. Effectively analyze and articulate sound opinions on a variety of complex concepts
2. Illustrate a variety of problem-solving strategies that strengthen college preparation and workforce readiness
3. Formulate a framework for applying a variety of technology and internet-based research to enhance information literacy and collaborative thinking

Effective Communicators

1. Demonstrate awareness and sensitivity to tone and voice in multiple forms of communication
2. Express concepts and ideas in a variety of forms
3. Enhance communiccation skills through the use of media rich or other technology resources

Global Citizens

1. Appreciate the value of diversity
2. Understand the range of local and international issues facing today's global community
3. Demonstrate awareness of the importance of cultural sensitivity and social responsibility in the 21st century