NEW JERSEY CENTER
FOR TEACHING & LEARNING

Progressive Mathematics Initiative® (PMI®)
MATH4448: Introduction to Calculus

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Course Credit: 1.0 NJCTL/1.0 Carnegie Units credit

Dates & Times:
This is a self-paced course, covering 15 modules of content. The exact number of hours that you can expect to spend on each module will vary based upon the module coursework, as well as your study style and preferences. You should plan to spend approximately 15 hours per credit working online, and up to 30 hours per credit working offline.

COURSE DESCRIPTION:
This course introduces the study of limits, continuity, differentiation, and integration. Concepts are presented and explored from symbolic, algebraic, graphical, and numerical perspectives. Topics include Limits & Continuity; Derivatives; Applications of Derivatives; Analyzing Functions Using Derivatives, Integration; and 2D Applications of Integration.

TEXTS, READINGS, INSTRUCTIONAL RESOURCES:
Required Texts:
- This course uses a free digital textbook accessible at: https://moodle.njctl.org/course/view.php?id=198

COURSE REQUIREMENTS:
In order to receive a Passing grade, the participant must complete the following course requirements:
1. Activities: A number of different learning activities will ensure participant engagement and learning in the course. These include:
   - Engage in video module lessons which demonstrate minimized direct instruction followed by frequent formative assessment.

- Completion of formative assessments aligned to learning objectives which include detailed analysis when answered incorrectly.
- Interaction with module discussion boards that allow conversation with peers and course instructors about the module's content, delivering that content to students. Discussion boards also serve as a place to ask and answer questions related to the module's content.

2. Mastery Exercises: For each module, these multiple-choice question quizzes assess the content knowledge gained in a module. Participants have the opportunity to retake; random questions are pulled from a larger question bank on each attempt ensuring varied questions.
3. Virtual Labs: In each module, a virtual lab write-up will be submitted. Virtual labs are interactive lab simulations that promote discovery-based student learning through real-world applications and analysis.
4. Module Exam: One is completed at the end of each module. It is a culminating exam consisting of multiple choice and free response questions aligned to the standards and objectives of the module.
5. Final Exam: At the end of the course, a comprehensive exam consisting of Multiple Choice and Free Response questions assesses the content knowledge learned throughout the course.

GRADE DISTRIBUTION AND SCALE:

Grade Distribution:

Module Exams	70%
Final Exam	10%
Labs	10%
Mastery Exercises	10%

Grade Scale:

A	93 – 100
A-	90 – 92
B+	86 – 89
B	83 – 86
B-	80 – 82
C+	77 – 79
C	73 – 76
C-	70 – 72
D	60.0 – 69.9
F	59.9 or below

ACADEMIC STANDING:
NJCTL has established standards for academic good standing within a student's academic program. Students enrolled in any NJCTL online course must receive an 80 or higher to successfully complete a course and receive credit for that course. An 80 is equivalent to a GPA of 2.7 or B-. Additionally, students in an endorsement program must receive a cumulative GPA of 3.0 for all courses combined in order to successfully complete the program.

ACADEMIC INTEGRITY:
Students must assume responsibility for maintaining honesty in all work submitted for credit and in any other work designated by the instructor of the course. Academic dishonesty includes cheating, fabrication, facilitating academic dishonesty, plagiarism, reusing /repurposing your own work, unauthorized possession of academic materials, and unauthorized collaboration.

DISABILITY SERVICES STATEMENT:
We are committed to providing reasonable accommodations for all persons with disabilities. Any student with a documented disability requesting academic accommodations should contact the Dean of Students, Melissa Axelsson, for additional information to coordinate reasonable accommodations for students with documented disabilities (melissa@njctl.org).

NETIQUETTE:
Respect the diversity of opinions among the instructor and classmates and engage with them in a courteous, respectful, and professional manner. All posts and classroom communication must be conducted in accordance with the student code of conduct. Think before you push the Send button. Did you say just what you meant? How will the person on the other end read the words?

Maintain an environment free of harassment, stalking, threats, abuse, insults or humiliation toward the instructor and classmates. This includes, but is not limited to, demeaning written or oral comments of an ethnic, religious, age, disability, sexist (or sexual orientation), or racist nature; and the unwanted sexual advances or intimidations by email, or on discussion boards and other postings within or connected to the online classroom.

If you have concerns about something that has been said, please let your instructor know.

CLASS SCHEDULE:

Module	Module Learning Outcomes	Assignments
1 – Limits & Continuity Part 1	● Interpret the rate of change at an instant in terms of average rates of change over intervals containing that instant. ● Represent limits analytically using correct notation. ● Interpret limits expressed in analytic notation. ● Estimate limits of functions.	● Mastery Exercises

2 – Limits & Continuity Part 2	● Determine the limits of functions using limit theorems. ● Determine the limits of functions using equivalent expressions for the function or the squeeze theorem. ● Justify conclusions about continuity at a point using the definition. ● Determine intervals over which a function is continuous. ● Determine values of x or solve for parameters that make discontinuous functions continuous, if possible. ● Interpret the behavior of functions using limits involving infinity. ● Determine limits of functions that result in indeterminate forms.	● Mastery Exercises
3 – Limits & Continuity Part 3	● Justify conclusions about continuity at a point using the definition. ● Determine intervals over which a function is continuous. ● Determine values of x or solve for parameters that make discontinuous functions continuous, if possible. ● Explain the behavior of a function on an interval using the Intermediate Value Theorem.	● Mastery Exercises ● Lab ● Module Exam (Calculator & Non-Calculator)
4 – Derivatives Part 1	● Determine average rates of change using difference quotients. ● Represent the derivative of a function as the limit of a difference quotient. ● Estimate derivatives. ● Interpret a limit as a definition of a derivative. ● Explain the relationship between differentiability and continuity. ● Calculate derivatives of familiar functions. ● Determine higher order derivatives of a function.	● Mastery Exercises ● Lab
5 – Derivatives Part 2	● Calculate derivatives of products and quotients of differentiable functions. ● Calculate derivatives of compositions of differentiable functions.	● Mastery Exercises
6 – Derivatives Part 3	● Approximate a value on a curve using the equation of a tangent line. ● Approximate a value on a curve using the equation of a normal line. ● Calculate derivatives of inverse and inverse trigonometric functions. ● Determine the equation of a line tangent to a curve at a given point. ● Apply the rules of derivatives to solve various problems.	● Mastery Exercises ● Module Exam (Calculator & Non-Calculator)
7 – Applications of Derivatives Part 1	● Interpret the meaning of a derivative in context. ● Calculate rates of change in applied contexts. ● Interpret rates of change in applied contexts. ● Calculate related rates in applied contexts. ● Interpret related rates in applied contexts. ● Calculate derivatives of implicitly defined functions.	● Mastery Exercises ● Lab

8 – Applications of Derivatives Part 2	● Make connections between position, velocity and acceleration functions. ● Approximate a value on a curve using the equation of a tangent line. ● Apply rules of differentiation to solve real world applications.	● Mastery Exercises ● Module Exam (Calculator & Non-Calculator)
9 - Analyzing Functions using Derivatives Part 1	● Justify conclusions about functions by applying the Extreme Value Theorem. ● Justify conclusions about the behavior of a function based on the behavior of its derivatives. ● Calculate minimum and maximum values in applied contexts or analysis of functions. ● Interpret minimum and maximum values calculated in applied contexts.	● Mastery Exercises ● Lab
10 -Analyzing Functions using Derivatives Part 2	● Justify conclusions about functions by applying the Mean Value Theorem over an interval. ● Justify conclusions about the behavior of a function based on the behavior of its derivatives. ● Calculate minimum and maximum values in applied contexts or analysis of functions. ● Interpret minimum and maximum values calculated in applied contexts. ● Determine critical points of implicit relations. ● Justify conclusions about the behavior of an implicitly defined function based on evidence from its derivatives. ● Apply function analysis to solve optimization problems.	● Mastery Exercises ● Module Exam (Calculator & Non-Calculator)
11 - Integration Part 1	● Interpret the meaning of areas associated with the graph of a rate of change in context. ● Approximate a definite integral using geometric and numerical methods. ● Interpret the limiting case of the Riemann sum as a definite integral. ● Represent the limiting case of the Riemann sum as a definite integral.	● Mastery Exercises ● Lab
12 - Integration Part 2	● Represent accumulation functions using definite integrals. ● Calculate a definite integral using areas and properties of definite integrals. ● Evaluate definite integrals analytically using the Fundamental Theorem of Calculus. ● Determine antiderivatives of functions and indefinite integrals, using knowledge of derivatives.	● Mastery Exercises
13 - Integration Part 3	● Find integrals using u-Substitution. ● Apply the mean value theorem to integrals. ● Apply the average value theorem to i ● Evaluate definite integrals analytically using the Fundamental Theorem of Calculus.	● Mastery Exercises ● Module Exam (Calculator & Non-Calculator)

14 - Applications of Integration Part 1	● Determine the average value of a function using definite integrals. ● Determine the average value of a function using definite integrals. ● Interpret the meaning of a definite integral in accumulation problems. ● Determine net change using definite integrals in applied contexts. ● Calculate areas in the plane using the definite integral.	● Mastery Exercises
15 – Reflection & Final Exam	● Prepare for exam through discussion board and/or meeting with professor	● Final Exam