UNIVERSITY OF NORTHWESTERN
ST. PAUL

OFFICE OF DUAL ENROLLMENT

MAT2121
Calculus and Analytic Geometry I

SPRING 2023

SYLLABUS

Version: OLG v7:07/22

University of Northwestern – St. Paul
Office of Dual Enrollment
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MAT2121 Calculus and Analytic Geometry I

University of Northwestern – St. Paul

COURSE DESCRIPTION

The study of functions, limits, derivatives and applications of derivatives such as maxima/minima and related rates.

Credits: 4

Prerequisites: C- or better in MAT2005 or MAT1126, or ACT Math score of 28 or above [SAT Math score of 650 or above]

INSTRUCTOR INFORMATION

Please see "Contacting the Instructor" on the course site.

COURSE OUTCOMES

At the end of this course, a successful student will be able to

- CO-1. Compute limits and derivatives involving algebraic (polynomial, rational, root), exponential, logarithmic, trigonometric, inverse trigonometric, and piece-wise defined functions using graphical, numerical, and analytic methods.
- CO-2. Determine continuity and differentiability of a function at a point and on an interval.
- CO-3. Interpret the definition of derivative as instantaneous rate of change and the definite integral as accumulated change.
- CO-4. Apply various differentiation techniques including sum, power, product, quotient, & chain rules and implicit differentiation for computation and for solving contextual problems, including optimization and related rates.
- CO-5. Compute antiderivatives of elementary functions and explain how the Fundamental Theorem of Calculus unifies the concepts of limit, derivative, and antiderivative.
- CO-6. Demonstrate effective problem solving and communication skills by analyzing problem situations, justifying solution methods, applying precise mathematical notation, interpreting outcomes in context, explaining key calculus concepts in both written and oral form, and implementing appropriate technology to explore calculus concepts.

LICENSING APPROVED STANDARDS

8710.3320 Middle Lvl Math

3.C.1.b : - analyze the interaction within and among quantities and variables to model patterns of change and use appropriate representations, including tables, graphs, matrices, words, algebraic expressions, and equations;

3.C.1.c : - represent and solve problem situations that involve variable quantities and be able to use appropriate technology;

3.C.1.f : - apply concepts of derivatives to investigate problems involving rates of change;

8710.4600 Mathematics

3.A.2 : - analyze the interaction between quantities and variables to model patterns of change and use appropriate representations including tables, graphs, matrices, words, ordered pairs, algebraic expressions, algebraic equations, and verbal descriptions;

3.A.3 : - represent and solve problem situations that involve variable quantities and use appropriate technology;

3.A.5 : - apply properties of boundedness and limits to investigate problems involving sequences and series;

3.A.7 : - apply concepts and standard mathematical representations from differential, integral, and multivariate calculus; linear algebra, including vectors and vector spaces; and transformational operations to solve problems;

3.C.8 : - numerical approximation techniques as a basis for numerical integration, numerical-based proofs, and investigation of fractals;

3.G.2.c : - using intuitive, informal exploration, and formal proof.

MATERIALS

Required Textbooks and Materials

This course uses the following open textbook at no cost to students. A link to a digital copy of the open textbook is provided on the course site.

OpenStax, *Calculus Volume 1*. OpenStax. 30 March 2016.

This course uses an online graphing calculator that is available at www.desmos.com.

Provided by Student

For this course, students will need access to Microsoft Office (available at no cost to students through the University of Northwestern-St. Paul), a PDF reader, and a standard internet browser. Please refer to the Tech Requirements found in the Technology Help section at the top of the course site for the full requirements.

In addition, students will need access to either a scanner or a digital camera for scanning written computation work as digital images to add to assignments.

GRADING POLICIES AND PROCEDURES

Course Grade Explanation

Assignments	**Grade Weight**
Practice Problems (14)	10
Discussion Forums (6)	12
Essay	3
Quizzes (13)	25
Midterm Exam	25
Final Exam	25
Total	100

Grading Scale Percentages

A	≥ 93	B	≥ 83	C	≥ 73	D	≥ 63
A-	≥ 90	B-	≥ 80	C-	≥ 70	D-	≥ 60
B+	≥ 87	C+	≥ 77	D+	≥ 67	F	< 60

Late Work

All assignments are due as described in the course syllabus and the course site. Students are responsible for meeting assignment deadlines. Late assignments will be automatically deducted one letter grade. The assignments will drop an additional grade per day it is late, up to a 50% deduction in grade; late assignments will be not be accepted for a grade beyond one week past the original deadline. Forum discussion activities must be completed on time to earn points. Late forum posts will earn zero points. Students should contact the instructor via e-mail if an extenuating circumstance exists.

Feedback Expectations

Students should expect feedback for their submitted assignments within 5 days of the assignment due date or the time of their submission, whichever is later.

INSTITUTIONAL POLICIES AND SERVICES

Guidelines and Information

Students are responsible for all content of the DE Student Handbook. The most recent version of the DE Student Handbook is located on confluence.unwsp.edu and includes the following policies and procedures:

- Deadlines for Dropping or Withdrawing
- Student/instructor Communication
- Appeals, Exceptions, Disciplinary Process, & Grievances
- Assignments (late work and plagiarism)
- Examinations
- Grading System

Instructors may have course-related expectations that further detail the policies and procedures outlined in the DE Student Handbook. Any such expectations must be provided to students in writing (e.g., handout, course site posting) prior to or at the beginning of the class.

Traditional undergraduate students enrolled in DE courses are subject to the traditional undergraduate student handbook for all non-course-specific policies and procedures.

Academic Integrity

Plagiarism is theft—theft of someone else's words or ideas. It is claiming another's work as one's own. This would also include the following:

- Using the words or work of a former or current student in this class
- Recycling previously submitted assignments from a previous course attempt
- Using outside literature support sites such as, but not limited to, SparkNotes, Enotes or Schmoop that provide literary analysis of the texts we read throughout the semester

Students found plagiarizing are subject to discipline. The standard response ranges from loss of credit for the plagiarized assignment to earning an immediate "F" for the course to being placed on disciplinary probation. We should be committed to conducting ourselves with integrity in all things**.** Please refer to the DE Student Handbook for more detailed information about UNW's honesty and integrity policies.

In every course, students are required to view the Understanding Plagiarism video and complete the Understanding Plagiarism Quiz prior to completing any of the course content. These items are part of the course orientation.

Academic Achievement

UNW students requesting academic accommodations in association with the Americans with Disabilities Act (ADA) are directed to notify Disability Services to begin the application process. Academic Achievement also provides the following: Writing Tutoring, Subject Tutoring, advocating, transitional skill building, Academic Coaching (organization, time management, test taking, etc.).

Contact Academic Achievement for more information: AcademicAchievement@unwsp.edu | 651-628-3316 | N4012 (Revised 07/21).

Support Services

Links to support services are available found in the Student Services section at the top of the course site.

COURSE POLICIES AND INFORMATION

Email and Announcements

Students are responsible to regularly check their Northwestern student email and the announcements in the course site in order to receive updates and information.

Attendance

Due to the accelerated nature of the online curricula, students are expected to participate in all course activities. Students must contact the faculty member in advance or as soon as possible if unable to participate in all or part of the course activities for a given week because of a medical (which includes having to quarantine or isolate due to COVID-19 exposure or confirmed illness), family, or work-related emergency. Students should refer to their course syllabus and/or faculty member for specific requirements. Students who do not participate in course activities and fail to withdraw from the course will receive a failing "F" grade.

Submission Standards

All written assignments should adhere to the following DE guidelines. Documents should be in the following format **unless directed differently by the syllabus or course instructor**:

- Submitted on the course site in Microsoft Word document format (.doc or .docx)
- Set in a traditional typeface 12-point font
- Double-spaced (unless the syllabus instructs otherwise)
- Set with one-inch margins
- Formatted in APA style for in-text citations and reference page (LIT1100 may ask for MLA documentation style)

- Labeled and submitted with the following information (APA papers require this information on a cover sheet, as detailed in A Pocket Style Manual): Student Name, Course Code and Title, Instructor Name, and Date.

Critical Response to Alternate Viewpoints

When students are reading or viewing course materials, they may encounter viewpoints, words, or images that their instructors would not use or endorse. Students should know that materials are chosen for their value in learning to read, write, and view critically, not because the materials are necessarily Christian.

ASSIGNMENTS

This course is delivered in an online format. The content for Calculus & Analytic Geometry I is divided into a total of 13 lessons, each taking 1 week. Two weeks of the course are designated to take exams. It is important to follow the instructions within this syllabus and the course site so you can stay on track with your studies. In this course you are trained to use contemporary technology (such as Microsoft Excel and Desmos) to visualize and help solve business problems. The course uses exercises and problem solving as the primary assessment tool.

See the course site for complete details on the assignments.

Interactive Reading and Exercises

The online textbook introduces you to new ideas and methods in Calculus. The reading includes interactive questions that allow you to test your knowledge along the way. Each reading section has about 60 exercises to practice Calculus ideas without being graded. Every other problem has a readily accessible answer. You are encouraged to complete every fourth problem, or every other problem with an answer. Thus, you will have completed about 15 problems as an introduction to the material. Feel free to complete other problems, especially over concepts that seem complicated at first. Once you feel you have made sufficient headway, you should proceed to the Practice Problems.

Practice Problems (15)

The online practice problems are an intensive training session on solving many types of problems in Calculus. Each problem usually has multiple parts to emphasize various aspects of the same concept or computational technique. Some items have videos you may view to help explain appropriate problem solving techniques. You should select alternate problems for items that you answer incorrectly. This way you will get training on specific content, and can incrementally improve your score. When you are satisfied with your score and feel ready to discuss the material with other student or take a quiz, you should proceed to any weekly Interactions.

Discussion Forums (6)

In your posts, you will address questions that demonstrate your current understanding of and insights about Integral Calculus. These forums allow you to begin thinking about the overall context of Differential Calculus, to identify your working knowledge of basic terms and concepts, and to share insights you have gained in technology-assisted short research assignments.

Minimum Requirements: Provide an initial post consisting of two paragraphs (at least 300 words) in which you articulate your current understanding or position on the topic as supported by course materials. These initial posts are due by 11:59 p.m. on Wednesday each week. Then reply in at least 100 constructive words to the thoughts of another colleague by 11:59 p.m. on Friday each week. You may choose to post more in order to generate further discussion or elicit responses and reflections from other learners (as indicated in the rubric).

For further specific grading criteria, view the Discussion Forum Rubric within each assigned discussion on the course site.

Essay (1)

Complete an essay related to a lecture presentation. Prompt questions are provided on the course site, and the essay should be at least 500 words answering the prompt question(s).

Quizzes (13)

For most weeks throughout the course, you will complete various quizzes related to weekly material, most of which are drawn from the online textbook. These will help you gain and practice the skills necessary for Differential Calculus problem solving. Beyond just seeking the correct answer, quizzes invite you to practice until Calculus concepts, methods, and perspectives become nearly automatic and intuitive as you grow in expertise.

For each week's Quiz, download and complete the Quiz Word document from the course site. Then, submit your completed document in the respective assignment submission area.

Most quiz and exam questions will be graded using the following five-point scale.

- **5 pts:** The response is a complete and full answer. All work is shown including necessary graphs and computer code, if applicable.
- **4 pts:** The response shows a proper process; however, there is a single logical or computational error.
- **3 pts:** The response shows overall work that is correct; however, the response shows a minor process error that results in one or more computational errors.
- **2 pts:** The response shows a completed subtask; however, the response shows a major error in reasoning or does not answer the question.
- **1 pt:** The response shows minimal work or lack of understanding of the process necessary to solve the problem.
- **0 pts:** The problem is omitted or is completely on the wrong track.

Midterm and Final Exams

Complete the midterm exam during week 7 and the final exam during week 15. The exams are open-book and not timed. You may use your online textbook (including formula sheets), graphing calculator, student notes, course website(s), video(s), Desmos, and other course materials, but you may not have assistance by any person or any other website (including www.wolframalpha.com) in completing the exam. You may

submit your work either scanned in a PDF file or entered in Microsoft Word using the Equation Editor. Scanned documents should be submitted online all in one file. A late exam receives a 10% deduction.

The final exam will emphasize concepts and computations from the second half of the course, but be prepared for some problems from the first half of the course. Make sure that you are fully prepared for this exam before attempting it.

COURSE SCHEDULE

Format

In this course you will be working through a free online textbook which offers both descriptive text and numerous interactive activities. Try the interactive example problems with paper and pencil first. Then click on the link to see how well you did. This kind of in-the-moment skill practice both helps to track your understanding of the basic concepts for the week and to help you actually internalize the concepts.

Everything you need to successfully complete this course in fifteen weeks is explained on the Course Site. Calculus and Analytic Geometry I is broken down into two midterms, each one culminating with an exam. Each of the Lessons will take approximately one week to complete. When you study, be sure to follow the suggested format explained for each lesson.

Weekly learning activities are organized by ACTIVITIES, PRACTICE, and INTERACTION. By following the recommended learning sequence, you will be able to easily interact with the course materials and accomplish the intended learning outcomes.

Activities

Most lessons include online reading from the OpenStax textbook, PowerPoint presentations and/or Video training sessions. The activities also include ungraded online exercises to familiarize you with new concepts, computational techniques and applications.

Practice

Most lessons also include required multiple-choice practice items. These practice items will solidify your understanding of concepts, and give you training with computational techniques and applications. Most of the multiple-choice practice items allow for multiple submissions and alternate problems to complete until you have mastered the content and feel ready for the upcoming quiz. Some of the multiple-choice practice items have videos that show how to successfully complete the problem.

Interaction

Each lesson includes learning activities designed for interacting with what you've read and viewed, as well as interacting with other participants in the course. The interactions include discussions, essays, quizzes and exams.

For this course, students will receive access to each week's work as the semester progresses. There will be due dates during the week, but most weekly assignments will be due by 11:55 p.m. on Friday. Please refer to the schedule for the due dates of assignments.

Generally, for college-level work, students should expect to have an average of 9.5 hours of homework per week.

The last official class day in Week 15 varies from semester to semester. Please refer to the Semester Calendar found in the Academic Information section at the top of the course site for the actual last day of class. All course work must be completed and submitted by that day.

Due Dates

All written assignments (outlined below) are to be submitted on the course site by 11:55 p.m. CT on Fridays at the end of each week in which they are assigned, unless otherwise noted.

For any questions regarding these assignments, contact the instructor.

Orientation

- Read the Getting Started Page
- Participate in the Introductions Forum
- View and Complete Understanding Plagiarism Presentation and Quiz
- Complete Student Responsibilities Exercise

Week 1: What functions are the basic building blocks of Calculus?

Activities

- View: Intro to your Instructor (1:17)
- View: Intro to your Textbook (4:30)
- View: Intro to DESMOS (6:50)
- Complete Interactive Reading and Exercises: Review of Functions
- Complete Interactive Reading and Exercises: Basic Classes of Functions
- View: DESMOS and Functions (3:54)
- Complete Interactive Reading and Exercises: Trig Functions

Practice

- View: Intro to Practice Problems (3:40)
- Complete Functions Practice Problems

Interaction

- Submit Functions Quiz

Week 2: What is happening near undefined points?

Activities

- Complete Interactive Reading and Exercises: Solving Trig Equations
- Complete Interactive Reading and Exercises: The Limit of a Function
- Complete Interactive Reading and Exercises: The Limit Laws

- View Advanced Thinking Video: Rationalizing/Factoring (4:41)

Practice

- Complete Limits Practice Problems

Interaction

- Submit Limits Quiz

Week 3: How do limits relate to graphs?

Activities

- Complete Interactive Reading and Exercises: The Precise Definition of a Limit
- Complete Interactive Reading and Exercises: Limits at Infinity and Asymptotes
- Complete Interactive Reading and Exercises: Continuity
- View Advanced Thinking Video: Making a Piecewise Function Continuous (3:45)

Practice

- Complete Continuity Practice Problems

Interaction

- Participate in the Limits Graph Discussion
- Submit Limits Graph Quiz

Week 4: How do I measure instantaneous change?

Activities

- Complete Interactive Reading and Exercises: Defining the Derivative
- View Advanced Thinking Video: Derivative with Limit Definition (5:14)
- Complete Interactive Reading and Exercises: The Derivative as a Function

Practice

- Complete Derivative Concepts Practice Problems

Interaction

- Participate in the Derivatives Intro Discussion
- Submit Derivatives Intro Quiz

Week 5: How do I compute derivatives for functions (part 1)?

Activities

- Complete Interactive Reading and Exercises: Differentiation Rules
- View: DESMOS and Derivatives (3:51)
- Complete Interactive Reading and Exercises: Rates of Change

Practice

- Complete Derivative Rules Practice Problems

Interaction

- Submit Derivative Techniques I Quiz

Week 6: How are functions, limits and derivatives related?

Interaction

- Complete and submit the Midterm Exam

Week 7: How do I compute derivatives for functions (part 2)?

Activities

- Complete Interactive Reading and Exercises: Derivatives of Trig Functions
- Complete Interactive Reading and Exercises: The Chain Rule

Practice

- Complete Chain Rule Practice Problems

Interaction

- Participate in the Derivative Techniques II Discussion
- Submit Derivative Techniques II Quiz

Week 8: How do I compute derivatives for amazing relationships?

Activities

- Complete Interactive Reading and Exercises: The Ellipse
- View: DESMOS and Implicit Relations (4:20)
- Complete Interactive Reading and Exercises: Rotation of Axes
- Complete Interactive Reading and Exercises: Implicit Differentiation

Practice

- Complete Implicit Differentiation Practice Problems

Interaction

- Participate in the Implicit Discussion
- Submit Implicit Quiz

Week 9: How do I apply derivatives to inverses?

Activities

- Complete Interactive Reading and Exercises: Inverse Trig Functions
- Complete Interactive Reading and Exercises: Derivatives of Inverse Functions
- Complete Interactive Reading and Exercises: Derivatives of Exp. and Log Functions

Practice

- Complete Log Derivatives Practice Problems

Interaction

- Submit Inverse Derivatives Quiz

Week 10: How do derivatives relate to graphs?

Activities

- Complete Interactive Reading and Exercises: Maxima and Minima
- Complete Interactive Reading and Exercises: Derivatives and the Shape of a Graph
- Complete Interactive Reading and Exercises: Applied Optimization Problems
- View Advanced Thinking Video: Maximizing Profits (6:35)

Practice

- Complete Graphs and Derivatives Practice Problems
- Complete Optimization Practice Problems

Interaction

- Submit Optimization and Graphs Quiz

Week 11: How do I relate derivatives and limits?

Activities

- Complete Interactive Reading and Exercises: The Mean Value Theorem
- Complete Interactive Reading and Exercises: L'Hôpital's Rule

Practice

- Complete Mean Value Practice Problems
- Complete L'Hôpital's Rule Practice Problems

Interaction

- Participate in the Deriv/Limits Discussion
- Submit Deriv/Limits Quiz

Week 12: How do I apply derivatives for problem solving?

Activities

- Complete Interactive Reading and Exercises: Related Rates
- View Advanced Thinking Video: Geometric Related Rates (4:03)
- View Advanced Thinking Video: Shadow Related Rates (5:57)
- Complete Interactive Reading and Exercises: Newton's Method

Practice

- Complete Related Rates Practice Problems

Interaction

- View Video: Newton's Method and EXCEL (7:54)
- Submit Newton's Method Essay
- Submit Related Rates Quiz

Week 13: How do I measure the area of crazy shapes?

Activities

- Complete Interactive Reading and Exercises: Approximating Areas
- View Video: Introduction to Sigma Notation (8:07)
- View Video: Finite Geometric Series (8:30)
- View Video: Finite Sums in DESMOS (1:26)
- View Video: Left Riemann Sums (3:54)
- View Video: Right Riemann Sums (3:21)
- Complete Interactive Reading and Exercises: The Definite Integral
- View Video: Definite Integrals Using DESMOS (1:35)

Practice

- Submit Series and Integrals Practice Problems (graded on completion)
    - Download the Word doc and submit your completed version

Interaction

- Participate in the Week 13 Discussion
- Submit Series and Definite Integral Quiz

Week 14: How can I undo derivatives?

Activities

- Complete Interactive Reading and Exercises: Antiderivatives
- View Video: The Antiderivative (10:23)
- Complete Interactive Reading and Exercises: The Fundamental Theorem of Calculus
- Complete Interactive Reading and Exercises: Net Change Theorem

Practice

- Complete Basic Integrals Practice Problems

Interaction

- Submit Integral Ideas Quiz

Week 15: Final Exam

The final week varies in length based on the semester. Please refer to the Semester Calendars found in the Academic Information section at the top of the course site for details.

Interaction

- Complete and submit the Final Exam