MAT106 Calculus I with Analytic Geometry
Fall, 2024—Spring, 2025
Prerequisite: College Trigonometry OR NCHS Precalculus AND teacher recommendation
5 Credit Hours (Lecture)
Course Length: 2 semesters
Instructor: Sharon Meyer
785-547-7085

**Department:**

Math / Science

**Course Description:**

Calculus I is the first in a three-semester sequence of calculus courses. This course consists of the study of algebraic functions of one variable, the use of modern technology to enhance calculus knowledge, limits including the study of L'Hopital's Rule, differentiation and its various techniques, definite and indefinite integrals, including integration by substitution and logarithmic functions, and applications of the derivative and definite integral in geometry, science, engineering, business, medicine, and other fields. Other topics will be covered as time permits.

**Course Competencies:**

The learning outcomes and competencies detailed in this syllabus meet or exceed the learning outcomes and competencies specified by the Kansas Core Outcomes Groups for this course as approved by the Kansas Board of Regents. (Kansas Regents Shared Number Course and Title: **KRSN Course MAT 2010 Calculus I**.)

Upon completion of the course, the student should be able to:

1. **Demonstrate an understanding of the concept of limits by exhibiting each of the following:**
   a. Evaluation of Limits
      i. Use the definition of a limit to verify a value for the limit of a function
      ii. Evaluate the limit of a function at a point both algebraically and graphically
      iii. Evaluate the limit of a function at infinity both algebraically and graphically
   b. Use of Limits
      i. Use the limit to determine the continuity of a function
      ii. Apply the Intermediate-Value Theorem
      iii. Use the limit to determine differentiability of a function
      iv. Use the limiting process to find the derivative of a function
2. **Demonstrate an ability to find the derivative of a variety of functions by exhibiting each of the following:**
   a. Find derivatives involving powers, exponents, and sums
   b. Find derivatives involving products and quotients
   c. Find derivatives involving the chain rule
   d. Find derivatives involving exponential, logarithmic, and trigonometric functions
   e. Find derivatives involving combinations of the above differentiation techniques
   f. Find derivatives involving implicit differentiation

Syllabus

3. **Demonstrate the ability to use derivatives to determine characteristics of a function by exhibiting each of the following:**
   a. Analysis of Curves
      i. Use the first derivative to find critical points
      ii. Apply the Mean-Value Theorem for derivatives
      iii. Determine the behavior of a function using the first derivative
      iv. Use the second derivative to find inflection points
      v. Determine the concavity of a function using the second derivative
      vi. Sketch the graph of the function using information gathered from the first and second derivatives
      vii. Interpret graphs of functions
   b. Applications of Derivatives
      i. Use the derivative to find velocity, acceleration, and other rates of change
      ii. Use the derivative to find the equation of a line tangent to a curve at a given point
      iii. Use optimization techniques in areas such as economics, the life sciences, the physical sciences, and geometry
      iv. Solve related rates problems
      v. Use Newton's Method
      vi. Use differentials to estimate change

4. **Demonstrate an ability to use the rules of integration to find the integral of a variety of functions by exhibiting each of the following:**
   a. Find area using Riemann sums and integrals
   b. Express the limit of a Riemann sum as a definite integral
   c. Evaluate the definite integral using geometry
   d. Integrate algebraic, exponential, and trigonometric functions
   e. Evaluate definite integrals using the Fundamental Theorem of Calculus
   f. Apply the Mean-Value Theorem for integrals
   g. Integrate indefinite integrals
   h. Integrate using substitution

**Course Content:**

A. Functions
   1. Functions
   2. Graphs of functions and operations
   3. Combining Functions
   4. Trigonometric Functions
   5. Graphing skills
      a. Shifting Graphs
      b. Scaling Graphs

Syllabus

   c. Graphing with Calculators
6. Exponential functions
7. Inverse functions
   a. Algebraic
   b. Trigonometric
   c. Logarithmic

B. Limits and Continuity
1. Rates of Change
2. Tangents to Curves
   a. Graphically
   b. By definition
3. Limits of a Function
4. Limit Laws
5. Rigorous Definition of a Limit [precisely, as it relates to calculus]
6. One-sided Limits
7. Two-sided Limits
8. Continuity
   a. By definition
   b. Use of the Intermediate Value Theorem
   c. Composite functions and general limits
9. Limits that involve infinity
10. Asymptotes of graphs

C. Differentiation
1. Tangents and the Derivative at a Point
2. The derivative as a function
3. Differentiation Rules
   a. Constant and exponential functions
   b. Power Rule
   c. Product Rule
   d. Quotient Rule
4. The Derivative as a Rate of Change
   a. Instantaneous rate of change
   b. Velocity [speed]/acceleration
   c. Application physics-type problems
5. Derivatives of Trigonometric Functions with applications
6. Derivatives utilizing Chain Rule and applications
7. Implicit Differentiation

8. Derivatives of Inverse Functions and Logarithms
    a. Logarithmic differentiation
    b. Inverse Functions / Logarithms / Exponentials
9. Inverse Trigonometric Functions
    a. Derivatives
    b. Limits
    c. Applications
10. Related Rates [applications]
11. Linearization and Differentials

D. Applications of Derivatives
1. Extreme values of functions
    a. The Extreme Value Theorem
    b. Local maximums / minimums
    c. Critical points of all types
2. The Mean Value Theorem and its applications
3. Monotonic functions
    a. Increasing/decreasing functions
    b. First Derivative Test
    c. Techniques for identifying local extrema
4. Concavity
    a. Identifying inflection points
    b. Second Derivative Test
    c. More advanced curve sketching techniques
5. Indeterminate Forms and L'Hopital's Rule for Indeterminate Forms
6. Applied Optimization
7. Newton's Method
8. Introduction to Indefinite Integrals ["Antiderivatives"]
    a. General antiderivatives by basic rules
    b. Initial value problems
    c. Antiderivatives and motion

E. Integration
1. Area and estimating area with finite sums
    a. Riemann sums and partitions
    b. Trapezoidal Rule
    c. Simpson's (Parabolic) Rule
    d. Distance traveled versus displacement

   e. Average value techniques
2. Sigma Notation
3. Limits and Values of Finite Sums
4. The Definite Integral
   a. Integrable and Nonintegrable functions
   b. Rules of definite integrals
   c. Area under a curve
   d. Average value over an interval
5. The Fundamental Theorem of Calculus [or FTC]
   a. Mean Value Theorem for Definite Integrals
   b. The Fundamental Theorem of Calculus Part 1 & Part 2
   c. Total Area
   d. Techniques for finding area with FTC
6. Indefinite Integrals and the Substitution Method
   a. Techniques explored
   b. Change of Limits Rule
7. Substitution and Finding Area
   a. Area Between Curves with respect to x
   b. Area Between Curves with respect to y

F. Applications of Integration
1. Volumes using Cross-Sections
   a. Volumes by Disks
   b. Volumes by Washers
2. Volumes by Cylindrical Shells
3. As time permits, Arc Length
4. As time permits, Areas of Surfaces of Revolution
5. As time permits, Derivatives and Integrals of exponential and logarithmic functions with bases other than *e*
6. As time permits, other applications to work, fluid, force, moments, and center of mass

**Learning Assessments:**

Course competencies will be assessed by written examinations covering all course material, including regular hour-long exams and a required, comprehensive final exam. Additionally, assessment may also occur through any of the following at the discretion of the instructor: regular collection of homework, in-class work, quizzes, portfolios, and various projects.

## Instructional Materials:

Textbook: Calculus : Early Transcendentals, 2nd Edition (2015), by William Briggs, Lyle Cochran, & Bernard Gillett; Pearson Education, Inc., Publishers. ISBN-13: 978-0321947345.

Assignments, journals, class notes and videos can be accessed on the website at: ncthunder.org/smeyer

## Policies:

Grades and behavior will be governed in this course according to the policies outlined in the Nemaha Central High School Handbook.

- Grades will be assigned using the NCHS Grading Scale; however, grades will NOT be rounded.
- Students will receive 4 homework coupons each semester that exempt a student from an assignment. Only two may be used prior to Oct. 15/Mar. 15. At the end of the semester, unused homework coupons will earn 5 pts. of extra credit per coupon. Put them in the pocket of the striped file on the back table.
- Homework is required. If an assignment has 7 or more problems, two problems may be omitted. They cannot be consecutive problems nor 2 word problems. Assignments with 6 problems or less must have all problems thoroughly attempted. Homework credit is all or none!
- Credit for homework will be granted for legitimately attempting to do the problem, not for whether the correct answer was reached. Answers are provided for all homework problems. Work must be shown!
- Assignment penalties:
  - Short 1 problem = -20%
  - Skip 2 in a row = -20%
  - Short more than 1 problem = Fix & Resubmit
  - Late within one week = -20%
  - Late more than one week = -50%
- Students will be given 50/50 at the start of each semester. Each time a student fails to communicate with the teacher prior to a known absence five points will be deducted.
- Tests must be completed during class unless prior arrangements have been made. Don't ask to come back later. No retakes!
- Any use of generative Computer Algebra Systems (CAS), AI tools or math problem solving apps to complete any coursework is prohibited unless explicitly allowed by the instructor for that particular assignment.

**Use of Artificial Intelligence (AI) Technology**

Any use of generative AI tools (i.e. chatGPT, Orca, etc.), Computer Algebra Systems (CAS), or problem solving apps to complete any coursework is prohibited unless explicitly allowed by the instructor for that particular assignment.

## Academic Integrity

Highland Community College faculty and students have the responsibility to maintain high academic standards. Academic dishonesty by students, which includes but is not limited to cheating, fabrication, plagiarism, or facilitation of academic work, is reason for disciplinary action. Students should submit their own academic work. Faculty should not allow or leave unreported academic dishonesty by the student.

First incident: Zero points awarded on assignment or lesson and documentation submitted to HCC's database system for tracking of multiple academic integrity issues. Communication between instructor and student.

Subsequent violations: Institutional response via the student conduct process. Meeting with the Vice President for Academic Affairs.

Incidents of academic dishonesty recorded in the student conduct system are cumulative; multiple or repeated incidents of academic dishonesty will be turned over to the conduct officer and ordinarily result in a medium-level sanction, which may include removal from the course with an F. However, repeated or severe violations may result in high-level sanctions, such as loss of scholarship or expulsion from the college.

A student may appeal decisions of academic dishonesty for the following reasons:

a. There were procedural errors made which significantly impacted the sanction or the findings.
b. The severity of the sanction imposed was not appropriate based on the nature of the violation or the circumstances.
c. New information is discovered that was not available at the time of the investigation that would significantly impact the sanction or the findings.

Academic integrity appeals will go through the Student Conduct Process. Please refer to the Student Handbook to review the full policy and appeal process.

**Guidelines for Requesting Accommodations Based on Documented Disability or Medical Condition**

It is the intention of Highland Community College to work toward full compliance with the Americans with Disabilities Act, to make instructional programs accessible to all people, and to provide reasonable accommodations according to the law.

Students should understand that it is their responsibility to self-identify their need(s) for accommodation and that they must provide current, comprehensive diagnosis of a specific disability or medical condition from a qualified professional in order to receive services. Documentation must include specific recommendations for

accommodation(s). Documentation should be provided in a timely manner prior to or early in the semester so that the requested accommodation can be considered and, if warranted, arranged.

In order to begin the process all students **must** complete the "Disabilities Self-Identification Form" on our Disability Services website.

This form can also be accessed at the Highland Community College homepage under Students Services/Student Resources/Disability Service or by contacting the Disabilities Coordinator.

**A Note on Harassment, Discrimination and Sexual Misconduct**

Highland Community College seeks to assure all community members learn and work in a welcoming and inclusive environment. Title VII, Title IX, and College policy prohibit harassment, discrimination and sexual misconduct. Highland Community College encourages anyone experiencing harassment, discrimination or sexual misconduct to talk to report to the Vice President for Student Services, the Human Resources Director or complete an online report about what happened so that they can get the support they need and Highland Community College can respond appropriately.

There are both confidential and non-confidential resources and reporting options available to you. Highland Community College is legally obligated to respond to reports of sexual misconduct, and therefore we cannot guarantee the confidentiality of a report, unless made to a confidential resource. Responses may vary from support services to formal investigations. As a faculty member, I am required to report incidents of sexual misconduct and thus cannot guarantee confidentiality. I must provide our Title IX coordinator with relevant details such as the names of those involved in the incident. For more information about policies and resources or reporting options, please review our Equity Grievance Policy.