MTH 265/266
Multivariable Calculus/Linear Algebra
School Year 2025-2026

Course Information

Purpose:This is the completion of the Calculus sequence and an introduction to Linear Algebra.
Intended Audience: Students intending to pursue an undergraduate degree in engineering,
mathematics, statistics, computer science, or physical sciences. This course is delivered
face-to-face and meets at the Governor's School.
Meeting times are listed below.

- Period 1: MTThF 7:10-7:55 AM, W 7:10-7:50 AM
- Period 7: MTThF 1:00-1:45 PM, W 1:10-1:50 PM
- Period 8: MTThF 1:50-2:35 PM, W 1:55-2:35 PM

Course Description and Credit Hours
 (4 credits per course)

Prerequisite(s): MTH 263 and MTH 264 or equivalent with a grade of C or better.

Multivariable Calculus: Focuses on extending the concepts of function, limit, continuity,
derivative, integral and vector from the plane to the three dimensional space. Covers topics
including vector functions, multivariate functions, partial derivatives, multiple integrals and an
introduction to vector calculus. Features instruction for mathematical, physical and engineering
science programs. Lecture 4 hours per week.

Linear Algebra: Covers matrices, vector spaces, determinants, solutions of systems of linear
equations, basis and dimension, eigenvalues, and eigenvectors. Features instruction for
mathematical, physical and engineering science programs. Lecture 4 hours per week.

Instructor Information
Name: Michael Menke
Email: michael.menke@nhrec.org
Office Hours: 2:35-3:00 PM
Office Location: A76 or via Zoom

Text(s) and Materials
Title: Calculus Early Transcendentals
Authors: Stewart
Publisher: Cengage Edition: 7th
Required or Recommended: Required
Title: Elementary Linear Algebra
Authors: Anton, Rorres

Publisher: Wiley Edition: 11th
Required or Recommended: Required

Course Materials You do NOT have to purchase the textbook! You'll occasionally need a calculator or ability to access online graphing software in this course. We will not use calculators on exams.

Course Policies
Homework assignments will be assigned regularly. Check your course calendar.

Quizzes will be paper and pencil based. There will be at least one quiz per unit.

Tests: There will be six tests. There will be no retests. Students are NOT allowed to use calculators on exams.

Lab: These labs are designed to provide hands-on activities, tests reviews, and collaborative supporting activities that will further your understanding of calculus. We will be introducing and using MATLAB software in this class.

Required Time-on-Task
This course is very intensive; 5 hours (outside of lecture) per week to study are required for successful completion of this course . Plan your semester so that you have enough time to be successful and time to get help when needed.

Grading/Evaluation Policy
Your final course grade is determined as the weighted average of the following:
Homework 10%
Quizzes 30%
Exams 45%
Lab 15%

The following grade average scale will be used to determine your final grade:
90 – 100%: A 80 – 89%: B 70 – 79%: C 60 – 69%: D Below 60%: F

Late Work Policy
Homework assignments are expected to be completed by the due date. Automatics extensions of one week from the original due date will be granted with a 10% penalty. Extensions beyond this will be subject to instructor's discretion.

Make-Up/Missed Test Policy
Students are expected to take tests in class, on the specified date (exceptions made for students with accommodation letters). If there are mitigating circumstances, contact me BEFORE the test if possible and provide documentation. In general, no make-up tests will be given (an exception may be made, but not more than once per student during the semester, if

the circumstances warrant it and you notify me before or on the test date, and you are able to take the test within two days of the scheduled date). No make-up test will be given to any student who does not show up on the test date and has not contacted the instructor. With the instructor permission make-ups be given after the tests have been returned.

College Math Expectations
In order for you to be successful in your mathematics courses, the faculty of the mathematics department has developed the following common expectations of all students in mathematics Courses.

1. College mathematics is different than high-school mathematics. College mathematics courses cover at least triple the material in the same time frame as do high school mathematics courses. A certain amount of material has to be covered during each class and over the semester. To maintain this pace, you need to take responsibility for your own learning. This includes, but is not limited to:
   ○ Having all required materials (e.g. textbook, a calculator required in the course syllabus, software course registration code, an access to a reliable computer with internet available at GSST or at home) the first day of class.
   ○ Reading the syllabus/Calendar/Assignments documents completely.
   ○ Logging in on CANVAS at least twice a week to check for Announcements, Assignment updates, and your grades, and checking VPCC email daily.
   ○ Reading the textbook section to be covered before coming to class, viewing any video lecture if available, listening to the lecture and taking notes, reviewing notes provided on CANVAS for each section.
   ○ Assign for study at least 5 hours outside of class per week for each week.
   ○ There is no substitute for continued and ongoing studying and doing homework problems. If you do not do all the assigned homework problems, your chances of success in any math class are very low.

2. It is your responsibility to keep your homework up-to-date and monitor your success. If you are having difficulty with the course material, then you need to take action right away – do not wait until you have lost all hope! There are several options to get assistance:
   ○ Talk to your instructor during office hours.
   ○ Form a study group with your classmates - this is the best thing you can do for yourself whether you are struggling or not.
   ○ Visit Brainfuse online using myVPCC website to access tutors. Tutor information and hours are available at http://libguides.tncc.edu/tutoring
   ○ No Generative AI Usage Permitted
   ○ For the duration of this course, the use of Generative AI in assignments is strictly prohibited.
   ○ Assignments are opportunities for personal growth, critical thinking, and applying your acquired knowledge. Your individual effort and creativity are essential in demonstrating your understanding of the course material. Dependence on AI

undermines these objectives and compromises the integrity of the learning process. We appreciate your commitment to academic honesty and dedication to upholding this course's principles by refraining from using Generative AI in your assignments.

Course Attendance Policy
Since this is a face-to-face class, attendance is measured in the traditional way: by attending class.

Calendar of Course Activities

The course calendar is linked in the Modules page of our Canvas course.
Any changes to the course calendar will be announced in class.

Cheating Policy
If a student cheats on an assignment, they will receive a 0 on that assignment, and the incident will be reported.

Student Learning Outcomes

Multivariable Calculus
Upon completing the course, the student will be able to:
● Vectors and the Geometry of Space
  ○ Identify and apply the parts of the three-dimensional coordinate system, distance formula and the equation of the sphere
  ○ Compute the magnitude, scalar multiple of a vector, and find a unit vector in the direction of a given vector
  ○ Calculate the sum, difference, and linear combination of vectors
  ○ Calculate the dot product and cross product of vectors, use the products to calculate the angle between two vectors, and to determine whether vectors are perpendicular or parallel
  ○ Determine the scalar and vector projections
  ○ Write the equations of lines and planes in space
  ○ Draw various quadric surfaces and cylinders using the concepts of trace and cross-section
● Vectors and the Geometry of Space
  ○ Sketch vector valued functions
  ○ Determine the relation between these functions and the parametric representations of space curves
  ○ Compute the limit, derivative, and integral of a vector valued function
  ○ Calculate the arc length of a curve and its curvature; identify the unit tangent, unit normal and binormal vectors
  ○ Calculate the tangential and normal components of a vector
  ○ Describe motion in space

- Partial Derivatives
  - Define functions of several variables and know the concepts of dependent variable, independent variables, domain and range.
  - Calculate limits of functions in two variables or prove that a limit does not exist;
  - Test the continuity of functions of several variables;
  - Calculate partial derivatives and interpret them geometrically, calculate higher partial derivatives
  - Determine the equation of a tangent plane to a surface; calculate the change in a function by linearization and by differentials,
  - Determine total and partial derivatives using chain rules,
  - Calculate directional derivatives and interpret the results
  - Identify the gradient, interpret the gradient, and use it to find directional derivative
  - Apply intuitive knowledge of concepts of extrema for functions of several variables, and apply them to mathematical and applied problems. Lagrange Multipliers.
- Multiple Integrals
  - Define double integral, evaluate a double integral by the definition and the midpoint rule and describe the simplest properties of them.
  - Calculate iterated integrals by Fubini'sTheorem
  - Calculate double integrals over general regions and use geometric interpretation of double integral as a volume to calculate such volumes. Some applications of double integrals may include computing mass, electric charge, center of mass and moment of inertia
  - Evaluate double integrals in polar coordinates to calculate polar areas, evaluate Cartesian double integrals of a particular form by transforming to polar double integrals
  - Define triple integrals, evaluate triple integrals, and know the simplest properties of them. Calculate volumes by triple integrals
  - Transform between Cartesian, cylindrical, and spherical coordinate systems; evaluate triple integrals in all three coordinate systems; make a change of variables using the Jacobian
- Vector Calculus
  - Describe vector fields in two and three dimensions graphically; determine if vector fields are conservative, directly and using theorems
  - Identify the meaning and set-up of line integrals and evaluate line integrals
  - Apply the connection between the concepts of conservative force field, independence of path, the existence of potentials, and the fundamental theorem for line integrals. Calculate the work done by a force as a line integral
  - Apply Green's theorem to evaluate line integrals as double integrals and conversely
  - Calculate and interpret the curl, gradient, and the divergence of a vector field
  - Evaluate a surface integral. Understand the concept of flux of a vector field
  - State and use Stokes Theorem

○ State and use the Divergence Theorem

Linear Algebra
Upon completing the course, the student will be able to:
● Matrices and Systems of Equations
  ○ Use correct matrix terminology to describes various types and features of matrices (triangular, symmetric, row echelon form, et.al.)
  ○ Use Gauss-Jordan elimination to transform a matrix into reduced row echelon form
  ○ Determine conditions such that a given system of equations will have no solution, exactly one solution, or infinitely many solutions
  ○ Write the solution set for a system of linear equations by interpreting the reduced row echelon form of the augmented matrix, including expressing infinitely many solutions in terms of free parameters
  ○ Write and solve a system of equations modeling real world situations such as electric circuits or traffic flow
● Matrix Operations and Matrix Inverses
  ○ Perform the operations of matrix-matrix addition, scalar-matrix multiplication, and matrix-matrix multiplication on real and complex valued matrices
  ○ State and prove the algebraic properties of matrix operations
  ○ Find the transpose of a real valued matrix and the conjugate transpose of a complex valued matrix
  ○ Identify if a matrix is symmetric (real valued)
  ○ Find the inverse of a matrix, if it exists, and know conditions for invertibility.
  ○ Use inverses to solve a linear system of equations
● Determinants
  ○ Compute the determinant of a square matrix using cofactor expansion
  ○ State, prove, and apply determinant properties, including determinant of a product, inverse, transpose, and diagonal matrix
  ○ Use the determinant to determine whether a matrix is singular or nonsingular
  ○ Use the determinant of a coefficient matrix to determine whether a system of equations has a unique solution
● Norm, Inner Product, and Vector Spaces
  ○ Perform operations (addition, scalar multiplication, dot product) on vectors in Rn and interpret in terms of the underlying geometry
  ○ Determine whether a given set with defined operations is a vector space
● Basis, Dimension, and Subspaces
  ○ Determine whether a vector is a linear combination of a given set; express a vector as a linear combination of a given set of vectors
  ○ Determine whether a set of vectors is linearly dependent or independent
  ○ Determine bases for and dimension of vector spaces/subspaces and give the dimension of the space
  ○ Prove or disprove that a given subset is a subspace of Rn

- ○ Reduce a spanning set of vectors to a basis
- ○ Extend a linearly independent set of vectors to a basis
- ○ Find a basis for the column space or row space and the rank of a matrix
- ○ Make determinations concerning independence, spanning, basis, dimension, orthogonality and orthonormality with regards to vector spaces
- Linear Transformations
  - ○ Use matrix transformations to perform rotations, reflections, and dilations in Rn
  - ○ Verify whether a transformation is linear
  - ○ Perform operations on linear transformations including sum, difference and composition
  - ○ Identify whether a linear transformation is one-to-one and/or onto and whether it has an inverse
  - ○ Find the matrix corresponding to a given linear transformation T: Rn -> Rm
  - ○ Find the kernel and range of a linear transformation
  - ○ State and apply the rank-nullity theorem
  - ○ Compute the change of basis matrix needed to express a given vector as the coordinate vector with respect to a given basis
- Eigenvalues and Eigenvectors
  - ○ Calculate the eigenvalues of a square matrix, including complex eigenvalues.
  - ○ Calculate the eigenvectors that correspond to a given eigenvalue, including complex eigenvalues and eigenvectors.
  - ○ Compute singular values
  - ○ Determine if a matrix is diagonalizable
  - ○ Diagonalize a matrix

Communication Policies

Students are encouraged to communicate with their instructors via Canvas. When communicating outside of Canvas by email, students must use their GSST e-mail account when contacting their instructor, other offices at the college, or interacting with classmates. When communicating with instructors outside of Canvas, students should include the course and section number in text of the message. Students are responsible for checking their Canvas inbox and their GSST/VCCS e-mail account regularly, daily at a minimum.

Instructor Email Response Policy
Email from students will be returned by the instructor within 24 hours during weekdays and within 48 hours on weekends.

GSST Policies
Students should refer to the Student Handbook for the full list and explanation of GSST policies related to students.

Accessibility Accommodations
GSST operates in compliance with the Americans with Disabilities Act

Academic Honesty
It is imperative that students maintain a high degree of individual honor in their scholastic endeavors. Scholastic dishonesty will not be condoned under any circumstances. Generally, scholastic dishonesty is interpreted as cheating on an examination or quiz, which includes giving or receiving information; copying, using unauthorized materials in tests; collaborating during examinations; substituting for another person or allowing substitutions during examination; plagiarizing or submitting work other than one's own; and colluding with another person or persons in submitting work for credit unless such collaboration is approved in advance by the instructor. Webster's Third International Dictionary defines plagiarism as follows: "Plagiarism--to steal and pass off, as one's own the ideas or words of another; to use without crediting the source; to present as new and original an idea or product derived from an existing source; to commit literary theft."

Technology Policy
Students in all modalities (face-to-face, hybrid, and online) will need access to a desktop or laptop computer and an internet connection suitable for using Canvas and other online resources necessary for success in their courses. Students who experience unexpected outages or other technology issues should contact their instructor as soon as possible. If email is unavailable, students should use other communication methods, such as the instructor's phone number.

Inclement Weather Policy
In the event of inclement weather, the GSST provides delay and cancellation information to local radio and television stations. If a student is still experiencing difficulties in transmission of Canvas assignments due to power or other outages, they should contact the instructor as soon as it is safe to do so via email, or call the instructor by phone, to resolve questions and concerns in a timely manner.

Attendance may affect overall course grade based on course-specific attendance policies. As per the Student Handbook, "students have the obligation to initiate their own withdrawals from classes" using the Student Information System (SIS). Students can withdraw up until the date listed on the academic calendar for the term using SIS or Navigate.

For Dual Enrollment Courses
The decision to dual-enroll in a course requires careful consideration. You have options, as you can see from the DE module on Faculty Advising Canvas course. You may wish to contact your top choice colleges to ask what the impact of taking a dual-enrollment course might be for your goals, particularly if you do not perform to your expectations in the course. Please be aware that you are generating a permanent college transcript with all the courses for which you are dual-enrolled. You can also use the dual-enrollment student guide from Transfer Virginia to help

you determine the potential impact.

If you choose to dual-enroll, you must monitor your course grade. If you find you are not earning grades you want to have on your permanent college transcript, you may consider dropping the dual-enrollment portion prior to the Add/Drop date for the term of the course, or to withdraw from the dual-enrollment portion prior to the Withdrawal date. If you choose to withdraw from dual enrollment for the class, you will still earn high school credit and can plan to be well-prepared for the class in college. Dropping will have no record on your transcript, while withdrawal will leave a note on your college transcript indicating you withdrew, but no grade will be recorded on your college transcript. You can request a decline or withdrawal form from me or from Mrs. Yee.

No matter what you choose to do, I will respect your wishes. I want to work with you to support your learning, but I cannot learn the information for you; you will have to invest effort in the course in order to succeed. This may require you to learn new learning strategies that you haven't used in the past. I will do my utmost to support your personal learning in the class and encourage you to pursue your goals.

Important Dual Enrollment Dates:

- **Registration begins: Wed 9/17**
    - **During Advisory block**
    - **All juniors will meet in A67 to help with account creation and registration**
    - **Seniors will stay in their science classes to register**
- **Last Day to Add: Fri 9/26**
- **Faculty Confirm Rosters Tues 9/30**
- **Last Day to Drop: Wed 10/8**
- **Last Day to Withdraw: Tues 11/25 (before Thanksgiving break)**
- **Grades Due to VPCC: Mon 1/26**
    -

Spring 2025: TBD

Check your GSST email and Canvas for current news and offerings.