



湖北工业大学
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Multivariable Calculus and Optimization
Course Code	MATH 2631
Semester	Summer 2026
Course Length	4 Weeks, 60 Contact Hours
Credits	4
Instructor	Wang Mei
Office	NO.2 Teaching Building B206
Email	15072447699@163.com
Prerequisite	MATH 1112 Calculus II

Course Description:

This course develops mathematical techniques used to study functions involving several variables and their applications in economics, business, statistics, engineering, and the social sciences. Topics include vector and matrix methods, systems of linear equations, geometry in multidimensional space, partial differentiation, multivariable optimization, multiple integration, coordinate transformations, and selected applications involving quantitative decision-making and probability models. Emphasis is placed on analytical reasoning, mathematical modeling, and interpretation of results in applied settings.

Delivery Mode: In-Person, Face-to-Face Instruction

Course Goals:

Students who successfully complete this course will demonstrate competency in the following general education core goals:

- **Critical thinking skills** – Students will engage in creative and/or innovative thinking, and/or inquiry, analysis, evaluation, synthesis of information, organizing concepts, and constructing solutions.
- **Communication skills** – Students will demonstrate effective written, oral, and visual communication.
- **Teamwork** – Students will demonstrate the ability to work effectively with others to support a shared purpose or goal and consider different points of view.
- **Social responsibility** – Students will demonstrate intercultural competency and civic knowledge by engaging effectively in local, regional, national, and global communities.

Student Learning Outcomes:

Upon completion of this course, students will be able to:

- Perform operations involving vectors and matrices and interpret their geometric meaning;
- Analyze systems of linear equations using matrix techniques;
- Represent and investigate lines, planes, and surfaces in multidimensional space;
- Compute and apply partial derivatives and total differentials;
- Solve unconstrained and constrained optimization problems;
- Apply Lagrange multiplier techniques and interpret economic or quantitative constraints;
- Evaluate improper integrals and multiple integrals;
- Use double and triple integrals in area, volume, expectation, and related applications;
- Apply coordinate transformations and Jacobians in multivariable integration;
- Interpret mathematical results within practical quantitative contexts.

Textbooks/Supplies/Materials/Equipment/ Technology or Technical Requirements:

Primary Text

Knut Sydsaeter, Peter Hammond, Arne Strom, & Andrés Carvajal.

Essential Mathematics for Economic Analysis, 6th Edition. Pearson.

Supplementary Reference

James Stewart, Daniel K. Clegg, Saleem Watson.

Calculus: Early Transcendentals, 9th Edition. Cengage Learning.

Course Requirements:

Problem Sets (20%)

Four problem sets distributed throughout the semester. Assignments emphasize vector operations, matrix methods, multivariable differentiation, optimization procedures, and multiple integration

Applied Quantitative Assignment (10%)

Students prepare an individual written assignment applying multivariable mathematical methods to an economic, business, management, or social science context. The focus is on mathematical formulation, interpretation of assumptions, and explanation of results.

Midterm Examination (25%)

The midterm evaluates the material covered during the first half of the course, including vectors, matrix algebra, systems of equations, determinants, functions of several variables, and partial differentiation.

Optimization Case Study (10%)

Students analyze a constrained decision-making problem involving optimization techniques. The report should include model construction, solution procedures, interpretation of optimal solutions, and discussion of assumptions and limitations.

Final Examination (35%)

The cumulative final examination assesses advanced differentiation techniques, optimization methods, multiple integration, coordinate transformations, and applied quantitative reasoning.

Assessments: Activity	Percent Contribution
Problem Sets (4)	20%
Applied Quantitative Assignment	10%
Midterm Examination	25%
Optimization Case Study	10%
Final Examination	35%

Grading:

Final grades will be based on the sum of all possible course points as noted above.

Grade	Percentage of available points
A	94-100
A-	90-93
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D	64-69
D-	60-63
F	0-59

Course Schedule:

The schedule of activities is subject to change at the reasonable discretion of the instructor. Minor changes will be announced in class, major ones provided in writing.

MATH 2631 Schedule		
Lecture	Topic	Readings
L1	Introduction to multivariable analysis; vectors and matrices	EMA 12.1
L2	Vector operations, norms, linear combinations	EMA 12.4, 12.9
L3	Dot products, geometric interpretation, projections	EMA 12.4, 12.9
L4	Lines and planes in three-dimensional space	EMA 12.10; Stewart Ch.12
L5	Matrix addition, multiplication, transpose	EMA 12.3, 12.5-12.7
L6	Systems of linear equations	EMA 12.2
L7	Gaussian elimination and matrix methods	EMA 12.8
L8	Determinants and matrix inverses	EMA 13.1-13.7
	Problem Set 1 Due	
L9	Applications of matrices; quadratic forms and review	EMA 13.8-13.12
L10	Functions of several variables and graphical representation	EMA 14.1-14.5
L11	Partial derivatives and economic interpretations	EMA 14.2, 14.6, 14.9
L12	Higher-order partial derivatives and convexity concepts	EMA 14.7-14.8
L13	Chain rules and implicit differentiation	EMA 15.1-15.4

L14	Linear approximations and differentials Problem Set 2 Due	<i>EMA</i> 15.8-15.9
L15	Midterm Examination	Lectures 1-14
L16	Unconstrained optimization: first-order conditions	<i>EMA</i> 17.1-17.3
L17	Second-order conditions and quadratic models	<i>EMA</i> 17.2, 17.4
L18	Optimization in higher dimensions; comparative statics	<i>EMA</i> 17.6-17.7
L19	Equality-constrained optimization: Lagrange multipliers	<i>EMA</i> 18.1-18.4
L20	Multiple constraints and economic interpretation Applied Quantitative Assignment Due	<i>EMA</i> 18.5-18.7
L21	Inequality constraints and Kuhn–Tucker conditions	<i>EMA</i> 20.1-20.3
L22	Improper integrals review; double integrals Problem Set 3 Due	<i>EMA</i> 10.7; <i>EMA</i> 16.1-16.3
L23	Multiple integrals and probability applications	<i>EMA</i> 16.4
L24	Triple integrals and change of variables Optimization Case Study Due	<i>Stewart</i> Ch.15.6-15.8
L25	Polar, cylindrical and spherical coordinates; comprehensive review Problem Set 4 Due	<i>Stewart</i> Ch.10.3; Ch.15.9
---	Final Examination	Lectures 1-25

Accommodation Statement

Academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor's attention, as he/she is not legally permitted to inquire. Students who may require assistance in emergency evacuations should contact the instructor as to the most appropriate procedures to follow.

Academic Integrity Statement

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in coursework may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional qualifications within or outside the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Other Items:

Attendance and Expectations

All students are required to attend every class, except in cases of illness, serious family concerns, or other major problems. We expect that students will arrive on time, be prepared to listen and participate as appropriate, and stay for the duration of a meeting rather than drift in or out casually. In short, we anticipate that students will

show professors and fellow students maximum consideration by minimizing the disturbances that cause interruptions in the learning process. This means that punctuality is a must, that cellular phones be turned off, and that courtesy is the guiding principle in all exchanges among students and faculty. You will be responsible for the materials and ideas presented in the lecture.

Assignment Due Dates

All written assignments must be turned in at the time specified. Late assignments will not be accepted unless prior information has been obtained from the instructor. If you believe you have extenuating circumstances, please contact the instructor as soon as possible.

Make-Up Work

The instructor will not provide students with class information or make-up assignments/quizzes/exams missed due to an unexcused absence. Absences will be excused and assignments/quizzes/exams may be made up only with written documentation of an authorized absence. Every effort should be made to avoid scheduling appointments during class. An excused student is responsible for requesting any missed information from the instructor and setting up any necessary appointments outside of class.

Access, Special Needs and Disabilities

Please notify the instructor at the start of the semester if you have any documented disabilities, a medical issue, or any special circumstances that require attention, and the school will be happy to assist.