湖北工業大學
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Vector Calculus
Course Code	MATH 2271
Semester	Winter 2026
Course Length	5 Weeks, 60 Contact Hours
Credits	4
Instructor	TBA
Office	TBA
Email	TBA
Prerequisite	MATH 1112 Calculus II

Course Description:

This course develops the calculus of scalar and vector fields in two and three dimensions, serving as a bridge between multivariable analysis and its geometric and physical applications. Students explore differential operators such as the gradient, divergence, and curl, and learn to compute line, surface, and volume integrals. Emphasis is placed on conceptual understanding and visual interpretation of key results, including Green's Theorem, Stokes' Theorem, and the Divergence Theorem, which unify diverse integration concepts. The course also cultivates analytical and computational proficiency for problems involving flux, circulation, potential functions, and transformations between coordinate systems.

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:

- Analyze and interpret vector fields using gradient, divergence, and curl;
- Evaluate line, surface, and volume integrals in Cartesian, cylindrical, and spherical coordinates;
- Apply coordinate transformations in multiple integrals and understand Jacobians;
- Formulate and solve problems using Green's, Stokes', and Divergence Theorems;
- Use vector calculus techniques to model physical systems in fields such as fluid flow, electromagnetism, and mechanics;
- Communicate solutions clearly using precise mathematical reasoning and appropriate notation.

Textbooks/Supplies/Materials/Equipment/ Technology or Technical Requirements:
Thomas' Calculus: Early Transcendentals, 15th Edition by Joel R. Hass, Christopher E. Heil, Maurice D. Weir, and Przemyslaw Bogacki. Pearson.

Course Requirements:

Class Participation
Active engagement in lectures, discussions, and tutorials reinforces conceptual depth. Students are expected to participate in collaborative problem sessions, peer discussions, and brief in-class exercises designed to strengthen spatial and analytical intuition.

Homework Assignments
Weekly assignments focus on computational mastery and conceptual understanding. Problems range from analytical derivations and symbolic manipulation to graphical interpretation of vector fields. Some questions encourage the use of software tools for visualization and numerical integration, allowing students to connect theory with applied contexts.

Midterm Exams
Two midterms assess the understanding of course material, emphasizing clarity of reasoning, accuracy of computation, and problem-solving strategy. Each midterm includes both procedural and conceptual questions (e.g., geometric interpretations of gradient and flux).

Final Exam
A comprehensive written exam covering the entire course. Students must demonstrate the ability to synthesize core theorems (Green, Stokes, Divergence) and apply them to new settings. Both structured and open-form problems test the integration of multivariable calculus concepts.

Assessments: Activity	**Percent Contribution**
Class Participation	10%
Homework Assignments	30%
Midterm Exams (2)	30%
Final Exam	30%

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 2271 Schedule

Lecture	Topic	Readings
L1	Review of 3D coordinate systems, vectors, and dot/cross products	Chapter 12
L2	Lines, planes, and quadratic surfaces	Chapter 12
L3	Vector-valued functions, curves in space, and tangent vectors	Chapter 13
L4	Arc length and motion along a curve	Chapter 13
L5	Curvature, normal and binormal vectors; velocity and acceleration	Chapter 13
L6	Functions of several variables; limits and continuity	Chapter 14
L7	Partial derivatives and differentiability	Chapter 14
L8	Gradient, directional derivatives, and tangent planes	Chapter 14
L9	Extrema, Lagrange multipliers, and applications	Chapter 14
L10	Introduction to double integrals over rectangles and general regions	Chapter 15
L11	Double integrals in polar coordinates	Chapter 15
/	**Midterm Exam 1 (L1-9)**	/
L12	Applications of double integrals: area, mass, and centroids	Chapter 15
L13	Triple integrals in rectangular coordinates	Chapter 15
L14	Triple integrals in cylindrical and spherical coordinates	Chapter 15
L15	Substitutions and coordinate transformations	Chapter 15
L16	Introduction to vector fields; graphical interpretation	Chapter 16
L17	Line integrals of scalar and vector fields	Chapter 16
L18	Path independence, conservative fields, and potential functions	Chapter 16
L19	Green's Theorem in the plane; applications to area and circulation	Chapter 16
L20	Surfaces in space and surface parameterization	Chapter 16
/	**Midterm Exam 2 (L10-18)**	/
L21	Surface area and surface integrals	Chapter 16
L22	Flux of a vector field; Divergence Theorem (Gauss' Theorem)	Chapter 16
L23	Stokes' Theorem and the unification of integral theorems	Chapter 16
L24	Advanced topics: vector identities, conservative fields, and applications	Chapter 16
L25	Comprehensive review and problem-solving workshop	All above
/	**Final Exam**	/

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 without 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.