MATH-273 Calculus III 4 credits Spring 2020 Eric Kuennen

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Class Time/Place: Mon, Tues, Wed, Fri: 11:30-12:30, in Swart Hall 5

Office Hours: Mon, Tues, Wed, Fri: 9:30-10:30 am, in Swart 111.
Thurs: 12:00-1:00 and 1:20-2:20 pm, in Swart Hall 111.

Above are my designated office hours. When I am not teaching a class, I am usually in my office and available to meet with you. My class schedule is posted on my door. Feel free to stop by at any time, or make an appointment by email if you prefer.

Course Webpage: (Canvas) https://uwosh.instructure.com

Prerequisites: Mathematics 172 (Calculus II) with a grade of C or better.

Textbook/coverage: *Calculus: Concepts and Contexts* (4th edition) by James Stewart. We will cover most of chapters 9-13. (These chapters are Volume 2 of the UW-Oshkosh Backpack Edition. They are also available separately under the title *Multivariable Calculus: Concepts and Contexts).*

Calculator: Department policy allows the use of TI-83, TI-83 Plus, TI-84 or TI-84 Plus calculators. The TI-89 or TI-92 (or similar calculator with symbolic capability) will not be allowed. Cell phone calculators will not be allowed on quizzes or exams. To develop a sound knowledge of fundamentals, not all quiz and exam questions will allow calculators.

Catalog Description: Vectors in two and three dimensions, dot and cross products, lines, and planes. Vector functions and their differentiation and integration. Multivariate differential and integral calculus, partial derivatives and their applications, gradients, and multiple integrals. Line and surface integrals, fundamental theorem of line integrals, Green's theorem, and Stokes' theorem.

Departmental Course Objectives:

Content Goal: Students should learn the skills and techniques of multivariable calculus, including:

1. **Two- and three-dimensional vectors:** Understand representations of vectors (algebraic and geometric). Understand and apply operations (including dot products and cross products) on vectors and interpret them geometrically. Understand standard applications (e.g., force, fluid flow, and electromagnetics).
2. **Multivariable functions:** Use various representations of multivariable functions including graphic, numeric and symbolic. Understand limits and continuity in higher dimensions. Visualize and interpret graphs of functions and quadric surfaces. Understand the relationship between the three standard coordinate systems (rectangular, cylindrical and spherical). Develop spatial sense, including the ability to visualize and sketch cross-sections and level curves and surfaces.
3. **Partial derivatives:** State and understand the definition of partial derivatives. Compute partial derivatives. Estimate partial derivatives numerically. Interpret partial derivatives geometrically. Understand the gradient, the chain rule, the differential, and directional derivatives. Understand tangent planes and their connections to linear approximations of two variable functions. Optimize functions, with and without constraint; identify local extrema and

saddle points using the second derivative test; and find global extrema on closed sets. Use LaGrange multipliers.

4. **Double and triple integrals:** Understand the definition of double and triple integrals. Approximate of double integrals numerically. Understand Fubini's Theorem. Set up and evaluate double integrals (using rectangular and polar coordinates) and triple integrals (using rectangular, cylindrical and spherical coordinates). Apply double and triple integrals to problems involving area, volume and mass. Recognize the Jacobian in the context of change of variables.
5. **Parameterization of plane and space curves, and surfaces:** Parameterize curves and use them to study motion and compute arc length. Parameterize surfaces.
6. **Vector Fields**: Set up and compute line integrals and surface integrals. Understand and apply the fundamental theorem for line integrals. Understand and apply Green's theorem, Stoke's theorem, and the divergence theorem. Understand and compute curl and divergence.

Communication Goal: Students should be able to interpret in their own words the major ideas of multivariable calculus and communicate in clearly stated, well-organized English these ideas to others.

Students should engage in written and oral mathematical discourse throughout the class; they should be given opportunities to communicate mathematically via class discussion, group projects and/or presentations of problem solutions.

Upon successful completion of the course, students should be able to communicate problem solutions, interpretations, and ideas and techniques of multivariable calculus in clear and well-organized written form, including the proper use of notation.

Connection Goal: Students should recognize both the internal connections within calculus and some of its connections with other areas of mathematics.

Students should be able to observe that the topics in multivariable calculus are generalizations of single-variable calculus. Students should also be aware that some problems encountered in the calculus sequence are not solvable using the techniques that they have learned (e.g., there exist indefinite integrals that have no anti-derivative).

Upon successful completion of the course, students should be able to:

- Use appropriate technology to assist in visualization and demonstrate the ability to do standard problems without relying on the calculator or software.
- Appreciate the usefulness of multivariable calculus for solving abstract and applied problems.
- Utilize the techniques of multivariable calculus in a broad range of applications from diverse fields such as physics, chemistry, biology, economics and/or mathematics.

Independent Learning and Reading Goal: Students should develop their ability to understand mathematical definitions and to construct and verify examples of mathematical objects in multivariable calculus; students should be able to use the ideas of multivariable calculus in somewhat unfamiliar contexts or in new applications.

Upon successful completion of the course, students should be able to read and understand material presented in the course through the textbook, handouts or other class media.

Problem Solving Goal: Students should be able to model real applications using multivariable calculus.

Upon successful completion of the course, students should be able to:

- Solve involved, multi-step problems.
- Solve problems requiring the cumulative content of the calculus sequence.

Reasoning and Validation Goal: Students should be able to provide convincing arguments to show that their solutions are correct. They should also be able to argue the verity of their solutions using multiple routes of explanation (e.g., numerically, graphically, verbally, algebraically.

Upon successful completion of the course, students should be able to:

- Provide formal definitions for fundamental objects in the calculus (e.g. limit, derivative, definite integral, etc).
- Demonstrate understandings of the proofs and derivations that are discussed in class.

Expectations/attendance: This course will make use of in-class group work and collaborative learning, and so you are expected to attend every class session and participate in group and class discussions. You are expected to read the text and work on the assigned exercises outside of class on a regular basis. The pace of this class will be fast, and the material is very sequential; if you do not keep up, you will be lost. If you are absent from class, you are responsible for the material covered. Arrange to copy another student's notes and be informed of any announcements made during class. As a rule of thumb, you should expect to spend 8-12 hours a week studying for this course.

Homework Exercises. Exercises from the text will be assigned on a daily basis for you to practice on. Success in the course requires that you work on these homework exercises. These assigned exercises will not be collected or graded, but they will be a primary model I use to write the problems on the problem sets and exams.

Problem Sets. There will be 7 graded problem sets, consisting of 8-10 non-trivial problems that will require exploration and explanation. You are encouraged to work together on these assignments. Learn from each other, discuss the problems and concepts, and investigate proposed solutions with your classmates. However, you then must be able to write up the solutions on your own and in your own words. Researched solutions will not be allowed.

Computer Lab Projects. There will be 4 graded computer lab assignments. UWO has a full site license for the Computer Algebra System **Maple**. This software can be accessed using any PC or Mac at any computer lab on campus. I will use Maple during in-class demonstrations, and we will hold class in the Swart 229A computer lab several times throughout the semester. You are encouraged to work in groups on the computer lab projects; however each student must submit only their own work. No late computer lab projects will be accepted.

Exams: There will be 4 exams given in class. These are tentatively scheduled for 2/28, 4/3, 5/1, and 5/15. Coverage will be announced in class prior to each exam. The last exam will be partly cumulative in nature. Except for illness documented with a written medical report or an emergency with prior or timely notification, there are no provisions for taking exams at any but these regularly scheduled times.

Grading: The graded Problem Sets and Computer Lab Assignments will comprise 20% of your grade. The 4 exams will each count as 20% of your grade.

The scale below shows the grade you will earn if you earn **at least** the given percentage of course points. Grades are based on performance, not need. No "extra" credit will be offered.

A	92%	B	82%	C	72%	D	62%
A–	89%	B–	79%	C–	69%	D–	59%
B+	86%	C+	76%	D+	66%	F	0%

Dropping / Incompletes According to the Student Bulletin, the primary responsibility of dropping a class resides with the student. February 16th is the last day to drop with a full refund. March 18th is the last day to withdraw from the course. A student wanting to drop a course after that deadline may appeal with a REQUEST FOR LATE DROP FORM describing relevant extenuating circumstances beyond the student's control. According to the Student Bulletin, an Incomplete grade can be assigned only when a student is unable to complete the course work because of illness, injury, or other extenuating circumstances beyond the student's control.

Academic Misconduct: Any form of academic misconduct including cheating on a quiz or exam, or in any way seeking to claim credit for the work or efforts of another person will be dealt with in accordance with system policy UWS 14, as referred to in the UW Oshkosh Student Discipline code. You are expected to behave with integrity and honor. The official UWO policy regarding academic misconduct can be found at https://www.uwosh.edu/deanofstudents/university-policies-procedures/academic-misconduct

Suggestions:

- Mathematics is not a spectator sport! You must get in the game and try it yourself. Even if you understand what is going on in class, you will not be successful on the exams unless you practice on the homework problems. You are encouraged to work in groups on your homework. Being able to communicate mathematically with others is a great way to understand mathematics. If your group is having difficulty with the homework, come to me for help. Class participation is crucial to success in a math class. Please feel free to ask questions and answer questions.
- The pace of this class will be fast. Do not fall behind. To be successful in mathematics requires a consistent effort. Do not work in spurts or just cram before the exams. Don't wait until you have fallen behind to seek help from me. This course will contain new and difficult ideas and it is always worthwhile to discuss homework or issues you have with the course with me. I interpret such consultation as a sign of strength and interest.
- In this class I will expect you to know ***why*** **as well as** ***how***. Think about the fundamental ideas and why the techniques work as well as how to apply them. Each exam will contain problems unlike those you have done before, but understanding the ideas will enable you to do all the problems.
- Read the text book! Often you will have to read the same section two or three times to understand all of what is being discussed. Don't simply use the text as a source of examples and exercises. Actually reading the text will help you understand the main ideas of the course and help your ability to communicate mathematically and solve problems.

Resources: There are many resources available to help you succeed in this course as well as thrive at UWO. If you are struggling with this course, please talk with me during office hours or make an appointment to meet outside of the scheduled times. Additionally, the following places are here to help you:

1. Center for Academic Resources: The Center for Academic Resources (CAR) provides free tutoring for students in most undergraduate classes on campus. CAR is located in the Student Success Center, Suite 102. Check the Tutor List page on CAR's website (www.uwosh.edu/car) for a list of tutors.
2. Other Resources: Please check out http://www.uwosh.edu/resources/ for additional resources available to you.