MULTIVARIABLE CALCULUS

MATH 2730.001

FALL 2011

Instructor: Dr. J. Iaia
Office: GAB 420
Office Hours: TTH 11-1, or by appt.
Webpage: http://www.math.unt.edu/~iaia

Time: MWF 11:00-11:50
Place: LANG 310
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Text: Briggs and Cochran, *Calculus*

Prerequisite: Math 1720 - Calculus 2

GRADING POLICY

Exam 1	*Sept.* 23	20%	
Exam 2	*Oct.* 21	20%	
Exam 3	*Nov.* 18	20%	
Final	*Dec.* 12	20%	10:30am-12:30pm
Homework	*daily*	20%	

Exams: Exams **must** be taken on the dates listed above. Exceptions will be considered *only* if one has **written documentation** certifying one's absence.

Homework: Homework will be assigned each class and collected weekly. Five problems will be chosen at random and graded. Homework is extremely important and students are highly encouraged to spend a lot of time working on the homework problems.

Attendance: **Students are responsible** for **all** work assigned and announcements made during any absence.

Code of Conduct: Students are expected to be *respectful of others* at all times. This includes keeping talk and other noise to a minimum while a lecture is in progress or an exam is being taken. Any student being disruptive may be dismissed from the class meeting. **Cheating** will **not** be tolerated and anyone found guilty of cheating may receive an F for the semester.

The **Student Evaluation of Teaching Effectiveness (SETE)** is a requirement for all organized classes at UNT. This short survey will be made available to you at the end of the semester, providing you a chance to comment on how this class is taught. I am very interested in feedback from students, as I work to continually improve my teaching. I consider the SETE to be an important part of your participation in this class.

Students with disabilities: It is the responsibility of students with disabilities to provide the instructor with appropriate documentation from the Dean of Students Office.

Semester grades are determined by averaging the grades on the 3 exams, the final exam, and the homework. Letter grades will be based on this average and will follow this scheme: **A 90- ;B 80-89; C 70-79; D 60-69; F -59**

Course Description

In this course we will learn about differentiation and integration of functions of more than one variable. We will begin by discussing *vectors* in two and three dimensional space. We will discuss the *dot product* of vectors which tells us something about the angle between two vectors and the *cross product* which given two vectors finds a third vector orthogonal to the given two. We will also determine the equation of a plane in three dimensions. Next we will study the quadric surfaces which include some of the basic shapes of functions that we will see in three dimensions: these includes spheres, saddle surfaces, hyperboloids, and elliptic paraboloids. The next topic will be the *partial derivatives* of a function $z = f(x, y)$ of two and three variables and *differentiable* functions of two and three variables. We will study the second partial derivative of functions and sufficient conditions to insure equality of mixed partial derivatives. We will then study the *directional derivative*, the *gradient* of a function, and the *chain rule*. The next topic will be *local maxima*, *local minima*, *absolute maxima*, and *absolute minima* of functions of two and three variables. We will also study *absolute maxima* and *absolute minima* of functions with constraints and *Lagrange multipliers*. Next we will study *double* and *triple integrals*, the *change of variables theorem*, and integrals in *polar coordinates* and in *spherical coordinates*.

Course Objectives

By the end of this course students will be able calculate partial derivatives of functions with more than one variable and discuss sufficient conditions for a function of more than one variable to have a local maximum or local minimum. Students will also be able to calculate the maximum and minimum of a function subject to some constraint condition. Students will be able to calculate directional derivatives and determine the direction in which a function changes most rapidly. Also students will able to recognize a number of common surfaces in three dimensions including spheres, cones, hyperboloids of one and two sheets, elliptic paraboloids, and hyperbolic paraboloids. Students will be able to calculate double and triple integrals and use these to determine the volume of a region cut out by a function. Students will be able to interchange the order of integration and how to use the change of variables theorem to convert integrals in rectangular coordinates to integrals in polar and spherical coordinates.

Course Outline

Meeting 1 - vectors in two and three dimensions, vector addition, vector subtraction, and multiplication of vectors by a scalar

Meeting 2 - the dot product of vectors, linearity of the dot product of vectors, length of vectors

Meeting 3 - proof that $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos(\theta)$

Meeting 4 - the cross product of vectors, linearity of the cross product of vectors, proof that $\mathbf{a} \cdot (\mathbf{a} \times \mathbf{b}) = \mathbf{b} \cdot (\mathbf{a} \times \mathbf{b}) = 0$, and $|\mathbf{a} \times \mathbf{b}| = |\mathbf{a}||\mathbf{b}| \sin(\theta)$

Meeting 5 - proof that the volume of the parallelepiped determined by vectors $\mathbf{a}$, $\mathbf{b}$, and $\mathbf{c}$ is $|\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}|$

Meeting 6 - determining the equation of a plane in three dimensions

Meeting 7 - sketching the graph of quadric surfaces: spheres, cones, and hyperboloids of one and two sheets

Meeting 8 - sketching the graph of quadric surfaces: elliptic paraboloids and hyperbolic paraboloids

Meeting 9 - definition and calculation of limits, the two path test for nonexistence of limits

Meeting 10 - definition of continuity and examples of continuous functions

Meeting 11 - review for exam 1

Meeting 12 - exam 1

Meeting 13 - definition and calculation of the partial derivatives of a function $z = f(x, y)$

Meeting 14 - definition of a differentiable function, proof that differentiability implies continuity

Meeting 15 - the chain rule

Meeting 16 - definition and calculation of the directional derivative, $D_{\mathbf{u}}f(x, y)$

Meeting 17 - proof that $D_{\mathbf{u}}f(x, y) = \nabla f(x, y) \cdot \mathbf{u}$

Meeting 18 - the tangent plane to the surface $z = f(x, y)$

Meeting 19 - level curves and level surfaces

Meeting 20 - local maximum and local minimum of $z = f(x, y)$, critical points

Meeting 21 - the second derivative test

Meeting 22 - proof of the second derivative test

Meeting 23 - review for exam 2

Meeting 24 - exam 2

Meeting 25 - absolute maximum and absolute minimum of $z = f(x, y)$

Meeting 26 - continuation of discussion absolute maximum and absolute minimum of $z = f(x, y)$

Meeting 27 - absolute maximum and absolute minimum of $z = f(x, y)$ subject to the constraint equation $g(x, y) = 0$, Lagrange multipliers

Meeting 28 - proof of the Lagrange multiplier method

Meeting 29 - definition of the double integral of a function over a rectangle, Fubini's theorem

Meeting 30 - the double integral of a function over a more general region

Meeting 31 - interchanging the order of integration in double integrals

Meeting 32 - continuation of discussion of double integrals

Meeting 33 - the change of variables theorem for double integrals

Meeting 34 - double integrals in polar coordinates

Meeting 35 - review for exam 3

Meeting 36 - exam 3

Meeting 37 - triple integrals and interchanging the order of integration in triple integrals

Meeting 38 - spherical coordinates

Meeting 39 - triple integrals in spherical coordinates

Meeting 40 - calculation of the Jacobian for the change of variables from rectangular coordinates to spherical coordinates

Meeting 41 - cylindrical coordinates

Meeting 42 - review for final exam

Meeting 43 - review for final exam

Meeting 44 - final exam