VECTOR CALCULUS
MATH 3740.001
SPRING 2014

Instructor: Dr. J. Iaia
Office: GAB 420
Office Hours: MW 9-11, or by appt.
Webpage: http://math.unt.edu/faculty-page-joe-iaia

Time: MWF 12:00-12:50
Place: CURY 211
email: iaia@unt.edu

Text: Marsden and Tromba, *Vector Calculus, 6th ed.*

Prerequisites: Math 2700 - Linear Algebra and Math 2730 - Calculus 3

GRADING POLICY

Exam 1	*Feb.* 7	20%	
Exam 2	*Mar.* 7	20%	
Exam 3	*Apr.* 11	20%	
Final	*May* 7	20%	10:30-12:30
Homework	*weekly*	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 begin with a study *vector fields* and the classic topics of *divergence, gradient*, and *curl*. We will discuss some of the physical meaning of these quantities and then we will move onto the study of the *change of variables* theorem including *polar coordinates* and *spherical coordinates*. Next we will study *path integrals* and *line integrals* over curves and we will show that these are independent of parametrization of these curves. We will then progress to the study of *regular surfaces* and to the definition of the *surface area* of a surface. This will lead to a discussion of surface integrals of vector fields and we will show that these are also independent of the parametrization of the surface. We will then define the *Gauss curvature* and *mean curvature* of a surface and we will calculate these for several surfaces. Then we will study the three great theorems of multivariable calculus: *Green's theorem, Stokes' theorem,* and *Gauss' theorem*. After this we will study *conservative fields* and show that a vector field is the gradient of a function if and only if the vector field is conservative. If time permits we will discuss *Lagrange multipliers* and the *implicit function theorem*.

Course Objectives

At the end of this course the students should be able to calculate the divergence and curl of a vector field and the gradient of a function. Students will be able to apply the change of variables theorem including polar and spherical coordinates to calculate many types of integrals. Students will also be able to calculate line integrals and they will be able to parametrize a variety of surfaces. The students will also be able to calculate the surface area of these surfaces and they will be able to apply Green's, Stokes', and Gauss' theorem to simplify these integrals. The students will also be able to calculate the Gauss and mean curvatures of a number of surfaces and be able to describe what these quantities tell us about the surface in question.

Course Outline

Meeting 1 - vector valued functions, definition of arc length

Meeting 2 - vector fields, divergence, gradient, and curl

Meeting 3 - maps from $\mathbf{R}^2$ to $\mathbf{R}^2$

Meeting 4 - the change of variables theorem, polar coordinates, spherical coordinates

Meeting 5 - applications to centers of mass and moments of inertia

Meeting 6 - improper integrals

Meeting 7 - the path integral

Meeting 8 - the line integral, reparametrizations

Meeting 9 - proof that the line integral is independent of parametrization

Meeting 10- line integrals of gradient vector fields

Meeting 11 - review for exam 1

Meeting 12 - exam 1

Meeting 13 - parametrized surfaces, regular surfaces

Meeting 14 - definition of surface area

Meeting 15 - justification for the definition of surface area

Meeting 16 - surface area of a graph of a function

Meeting 17 - integrals of functions over surfaces

Meeting 18 - surface integrals of vector fields

Meeting 19 - oriented surfaces

Meeting 20 - proof that the surface integral over an oriented surface is independent of parametrization

Meeting 21 - applications in differential geometry, Gauss curvature, mean curvature

Meeting 22 - Green's theorem

Meeting 23 - review for exam 2

Meeting 24 - exam 2

Meeting 25 - continuation of Green's theorem

Meeting 26 - proof of Green's theorem over a simple region

Meeting 26 - generalizations of Green's theorem

Meeting 27 - Stokes' theorem for parametrized surfaces

Meeting 28 - Stokes' theorem for graphs

Meeting 29 - proof of Stokes' theorem

Meeting 30 - gradient, divergence, and curl in spherical coordinates

Meeting 31 - conservative fields

Meeting 32 - proof that a vector field is the gradient of a function if and only if the vector field is conservative

Meeting 33 - Gauss' theorem

Meeting 34 - continuation of Gauss' theorem

Meeting 35 - review for exam 3

Meeting 36 - exam 3

Meeting 37 - proof of Gauss' theorem

Meeting 38 - Lagrange multipliers

Meeting 39 - inverse function theorem

Meeting 40 - implicit function theorem

Meeting 41 - applications of the implicit function theorem

Meeting 42 - review for final exam

Meeting 43 - review for final exam

Meeting 44 - final exam