Math 20550 - Calculus III
Course Syllabus
Summer 2016

Instructor	Edward Burkard	Brian Stoyell-Mulholland
E-mail	eburkard@nd.edu	bstoyell@nd.edu
Office	Hurley 295	Hayes-Healy 253B
Office Hours	and by appointment	and by appointment

Class Time : MTWRF 8:45-10:30
Class Location : DeBartolo
Course Webpages : http://www3.nd.edu/∼eburkard/?page=Teaching/20550U16
http://www3.nd.edu/∼bstoyell

1. Course Description

From the catalog: A comprehensive treatment of differential and integral calculus of several variables. Topics include space curves, surfaces, functions of several variables, partial derivatives, multiple integrals, line integrals, surface integrals, Stokes theorem, and applications.

My Description: This course covers the calculus of functions of several variables and vector valued functions. In this course, we will cover generalizations of results from Calculus I & II to higher dimensions; generalizations of results such as the second derivatives test, u-substitution, and the fundamental theorem of calculus; as well as topics unique to higher dimensions. We will go over several physics applications throughout the class in order to illustrate the extraordinary usefulness of the calculus of several variables; for example, conservation of energy, Gauss' law, Ampère's law, and Maxwell's equations. Calculus III is also the "baby version" of the mathematical field called *Differential Geometry*, which is fundamental to modern physics. I will hint at the more general versions of results occasionally to give you an idea of what comes after this class.

2. Prerequisites

The prerequisite for this class is Math 10560 (Calculus II) or Math 10860 (Honors Calculus II), or their equivalents. Basically, you will need to be able to carry out integration and differentiation, as well as know how to apply these in various ways as was done in Calculus I&II, e.g., extremization, finding areas, etc.

3. Course Format

This class will be different from a traditional lecture in that you will watch video lecture at home and we will do many practice problems in class. After a lecture video, there will be a question to check comprehension, but the bulk of assigned problems will be done in class. Thus, it is imperative that you do your homework **on time, every day!!!**. The class will be divided into groups, and each group will work together to solve the problems on the worksheet for the day.

4. Course Technicalities

Each class meeting is 105 minutes, approximately 2 standard semester class meetings. This means you will be expected to work twice as hard each day as you would during the semester. Class also meets all 5 weekdays, so you should expect to be studying Calculus every day! An inescapable fact of summer school courses is that they are quite dense.

5. Grade

There is a total of 600 points for the class. The point breakdown is as follows:

Item	Exam I	Exam II	Exam III	Final	Classwork	Project	Lightboard
Points	60	100	100	150	120	50	20
% of grade	10	$16\frac{2}{3}$	$16\frac{2}{3}$	25	20	$8\frac{1}{3}$	$3\frac{1}{3}$

Your grade will be determined by the percentage of the total points you've obtained. The grade scale will be no stricter than

Letter	A	B	C	D	F
Cutoff	92%	82%	72%	57%	0%

with +'s and −'s to be used as needed for the final grade only. Due to the fact that there are no Math for Everyone talks over the summer, there will be other extra credit opportunities at some point.

6. Textbook

The textbook for this class is *Calculus, 7e*, by James Stewart. If you took Calculus during the year here, you should be set to go already. If you have not, I think the cheapest option would be to buy Webassign access through their website, and if you want a hard copy of a book, the previous editions of the textbook can be found cheaply online. There are other books, which I personally think are better, that you could also buy:

- Calculus by Larson - This book is at the same level as Stewart, and in my opinion, much better.
- Vector Calculus By Colley - This book gives you a "proper" coverage of the calculus of several variables using linear algebra. For the student wishing to go further in math, I highly recommend this book.

Calculus, at this level, has been the same for over 100 years at this point. There really isn't anything new to say in newer editions. The only reasonable thing to expect from newer editions of books is better expositions of material and maybe a better pedagogical flow.

7. Exams

There will be 3 exams over the course of the class, and will take place during the regularly scheduled class time, 8:45-10:30. Exam I will only cover Chapter 12, and as such will be shorter than the other exams. Exam I will take place on the first Friday of the class, June 17th. This is intended to give you feedback at the end of the first week, so you can gauge where you are in the class (since 1 summer week = $3\frac{1}{3}$ standard semester weeks). There will be a short worksheet after Exam I. Exam II will take place on July 1st and will cover through Chapter 14. Exam III will take place on July 14th and will cover up through Section 16.4, on Green's Theorem. There will also be a cumulative final exam on the last day of the class, July 22nd.

Exam make ups will only be given with an excuse from the appropriate campus personnel. Anyone who misses an exam and does not have an appropriate excuse will receive a 0 for that exam. Travel plans, sleeping in, defective alarm clocks, etc. ARE NOT a valid excuse for missing an exam. If you have a valid excuse (illness, excused athletic absence, etc.) for missing an exam, please contact me ASAP (preferably before the exam) and a makeup exam will be scheduled. NO CALCULATORS will be allowed on the exams.

8. Homework

Homework is a crucial part to this course because, unlike conventional courses, the lecturing is done outside of class. Your webassign will include videos explaining the content that you are learning alongside practice problems for comprehension. Doing the homework before class is crucial to your understanding, since we will be working in small groups to really get to know the material in class. Your classmates will be depending on you to know how to do the problems, so by not doing the homework you will not only hurt yourself but also your fellow classmates. Your homework is therefore considered part of your classwork and will be affecting the 120pts allocated in the grading scheme. The homework is done online though WebAssign, and can be accessed at webassign.net. The class key is:

nd 0269 9023

If you had Calculus I or II and already have a WebAssign username, you can log in with that. If you don't have a WebAssign account, the procedure is as follows:

(1) go to webassign.net
(2) click on "I Have a Class Key"
(3) enter the class key from above
(4) verify that the course is "Math 20550 — Section 01". I should show up as the instructor, and University of Notre Dame should show up below that.
(5) click on "Yes, this is my class."
(6) choose "I need to create a WebAssign account" and click continue
(7) you will then be asked to fill out several fields:

Username- this can be anything you want, as long as it's something you'll remember. A good option is your netID
Password- your choice. It is highly recommended you use a password distinct from your Notre Dame password.
First Name- please enter this *exactly* as it appears on your Notre Dame ID.
Last Name- please enter this *exactly* as it appears on your Notre Dame ID.
Email Address- please use your Notre Dame email address.
Student ID Number- please use your netID, **NOT** the ID number on your ID card.

I ask that you use this information because I need to be able to match it to the information provided to me by the registrar in order to assign you a homework grade.

(8) Create your account. You'll be ready to start your homework now!

It's worth pointing out that you get the first 2 weeks of access for free, so you don't have to actually purchase anything for a little while. It is highly suggested that you keep a notebook with your solutions to your online homework so that you can have a record of how to solve the problems to study from.

You are expected to turn in your own work. You are allowed to, and even encouraged to, work together on the homework, but you must turn in your own work. In particular, you are not allowed

to share your WebAssign password with someone else, nor are you allowed to have someone else enter solutions into WebAssign for you.

9. Classwork

During class, you will be split into small groups. Each group will send a representative up to the board to do the problem. Your group can assist you, but you should be the primary author of the solution. After you complete the problem in order to encourage collaboration, we want you to take a picture of solution and "tweet it" at the class's twitter account. The Twitter handle is @NDCalc3 This way by following the classes twitter, you can see yours and your fellow students different attempts at the problems we did in class.

10. Lightboard

In many career paths you will have to incorporate technology into your presentations. In order to help facilitate this we are going to have you use the lightboard, the same technology we use to create your video lectures. In order to complete this assignement you have to pick a problem from a Calc 3 Exam. You will write up a solution to the problem, then you and I will go to the Lightboard in Jordan Hall and you will present the problem on the Lightboard. This may take a couple takes depending on your familiarity with the problem. (Note: This problem has to be unique so if someone else asks to do a problem, you can't do the same problem.) After recording the problem, the video will be edited and available to your fellow students. This way we can compile a database of exam problems to help you all study for the FINAL!! da-da-da-da

11. Project: Presentation of an Application

In order to give you a deeper understanding of the material as it relates to the "real world", you will have to give an approximately 10 minute presentation on an application of something from the course material. A rough timeline for the project is: have a topic picked by the end of week 2, by the end of week 3 have a paragraph or so describing what you will talk about, submit a copy of your presentation materials to me at least 2 days BEFORE your presentation, and finally give your presentation at any point you're ready given two constraints: 1) you MUST present on July 20th at the LATEST and 2) your presentation should take place AFTER the material is presented in class.

12. Attendance

It is imperative that you attend class every day. Not only does it contribute to a portion of your grade, but falling behind by one class day is the equivalent of falling behind by two days during the semester, almost an entire week!! This compounds with the fact that class takes place every day, so you don't even have the day in between classes like you would in the normal semester to catch up. As attendance cannot be made up, if you miss class with an approved excuse, you will need to make up the worksheet and post your results to Twitter in order to be given the attendance points for the day(s) missed.

13. Help Resources

There will be tutoring available on Tuesdays and Thursdays from 3-4pm through the Learning Resource Center (LRC).

The textbook has a companion webpage:

stewartcalculus.com

which contains several helpful things such as: homework hints, additional resources for various topics throughout the text, among other things. When choosing your book, you should actually choose the "Early Transcendentals" version of the book to make the chapters match up. If you choose the other, all the chapters for this class are one further (e.g., chapter 12 on vectors is now chapter 13). There is no difference in content however.

I will have office hours, and if you need extra help, I'm willing to set up extra time to meet with you.

14. Mathematical Software

Frequently in the lecture videos, I will use the software *Mathematica* to create visuals of various concepts. A free copy of Mathematica is available to you through the OIT website:

oit.nd.edu/software-downloads/mathematica/

This requires that you log in with your netID. I highly recommend getting this, or some other software, in order to help you visualize things. I do want to emphasize, this is recommended, not required. My code for the demonstrations will be available on the course webpage.

15. Honor Code

As members of the Notre Dame community, we will not tolerate academic dishonesty. The Honor Code is in effect for all exams. Students will not give or receive aid on exams. This includes, but is not limited to, viewing the exams of others, sharing answers with others, and using books or notes while taking the exam. You may not talk about an exam to anyone who has not already taken it until the answers are posted on the website. This includes people who are not taking the course! Violations will not be tolerated and will be prosecuted! Please see the above section on homework for details about the Honor Code relating to homework. You can find more about the Honor Code here: honorcode.nd.edu

16. Conduct

You are expected to act in a respectable manner. If you are disruptive, you will be asked to leave, and you will forfeit your attendance points for the day. If you have a cell phone, please place it on silent during class time. Classes being interrupted by cell phones going off is disrespectful and extremely annoying.

17. Other Important Information

The drop deadline to receive a full refund is June 20th, and the standard drop deadline is July 2nd. Dropping after July 2nd will result in a "W" on your transcript.

I reserve the right to change any information in this syllabus in the event of unforeseen circumstances.

18. Course Outline

Here is a proposed course outline. This will be adjusted if needed as the course progresses.

6/13
- Introduction
- Review Prerequisites

6/14
- 12.1 - $\mathbb{R}^3$, Distance, Spheres
- 12.2 - Vectors, Forces
- 12.3 - Dot product, Work

6/15
- 12.4 - Cross Product
- 12.5 - Lines in Space: parametric, vector, symmetric; Planes: standard and vector forms, intersection of two planes, distance between points, planes, and lines

6/16
- 12.6 - Surfaces in Space: cylinders and quadratic surfaces
- Review and Practice for Exam I

6/17 EXAM I (50 minutes)
- 13.1 - Vector Functions and Space Curves

6/20
- 13.2 - Derivatives and Integrals of Vector Valued Functions
- 13.3 - Arc Length, Parameterizing by Arc Length, Curvature, Frenet-Serret Frame, Normal and Osculating Planes

6/21
- 13.4 - Velocity and Acceleration, Projectile Motion
- 14.1 - Functions of Several Variables, Graphs, Level Curves/Surfaces, Contour Plots

6/22
- 14.2 - Limits, Continuity
- 14.3 - Partial Derivatives, Higher Order Partial Derivatives, Clairaut's Theorem

6/23
- 14.4* - Definition of Differentiability, Differentiability $\Longrightarrow$ Continuity
- 14.6 - The Gradient
- 14.5 - Chain Rule, Implicit Differentiation, Related Rates

6/24
- 14.6 - Directional Derivatives, Tangent Planes, Normal Lines

6/27
- 14.7 - Absolute and Relative Extrema, Critical Points, Second Derivatives Test, Optimization

6/28
- 14.8 - Lagrange Multipliers

6/29
- 15.1 - Double Integrals over Rectangles
- 15.2 - Iterated Integrals
- 15.3 - Double Integrals over General Regions

6/30
- Review/Practice for Exam II

7/1 EXAM II (Written to be a 75 minute exam)

7/4 Independence Day - No Class

7/5
- 15.4 - Double Integrals in Polar Coordinates
- 15.7 - Triple Integrals

7/6
- 15.5 & 15.7 - Mass, Moments, Center of Mass
- 15.8 - Integration in Cylindrical Coordinates
- 15.9 - Integration in Spherical Coordinates

7/7
- 15.10 - Change of Variables
- 16.1 - Vector Fields

7/8
- 16.2 - Scalar Line Integrals, Mass, Center of Mass, Vector Line Integrals, Work
- 16.5 - Curl, Divergence

7/11
- 16.3 - Fundamental Theorem of Line Integrals, Conservative Vector Fields, Conservation of Energy
- 16.4 - Green's Theorem
- 16.5* - Vector Forms of Green's Theorem

7/12
- 16.6 - Parametrized Surfaces, Normal Vectors and Tangent Planes, Surface Area

7/13
- Review/Practice for Exam III

7/14 EXAM III (Written to be a 75 minute exam)

7/15
- 16.7 - Surface Integrals, Orientation/Orientability of a Surface, Flux Integrals

7/18
- 16.8 - Stokes' Theorem
- 16.9 - Divergence Theorem

7/19 • Review/Presentations
7/20 • Last day for presentations!
• Review
7/21 • Review
7/22 FINAL (Written to be a 100 minute exam)