

# MAT 261 - Multivariate Calculus

Syllabus

Dr. R.L. Herman

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## Course Content:

**Required Text:** *Calculus* 8th ed, by James Stewart, 5th ed., Cengage Learning, 2016.

We will cover all of chapters 12-16 in the text. In this course we will extend the notions of the derivative and the integral to cover applications in two and three dimensions. The topics will include partial derivatives, multiple integrals and the calculus of vector-valued functions.

During a typical week there will be several lectures, covering the text material. There will also be project assignments periodically in the form of whose completion will result in written reports on your findings.

## Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- ▶ Use a variety of techniques to solve homogeneous. Analyze and visualize curves, surfaces, and regions in 2 and 3 dimensions, in Cartesian, polar, cylindrical, and spherical coordinate systems.
- ▶ Compute derivatives and integrals of real valued and vector valued functions of several variables
- ▶ Perform additional operations on vector-valued functions including limits, finding curvature, and describing motion in space.
- ▶ Perform additional operations on functions of several variables including limits, partial derivatives, directional derivatives, and multiple integrals.
- ▶ Find and classify extrema of functions of several variables, with and without constraints, to optimization problems.
- ▶ Interpret geometrically the derivatives and integrals of real valued and vector valued functions of several variables.

- ▶ Demonstrate the use of the fundamental vector theorems (the Fundamental Theorem of Line Integrals, Green's Theorem, the Divergence Theorem, and Stokes' Theorem).
- ▶ Apply analytical and computational techniques of multivariable calculus to problems in mathematics, the physical sciences, and engineering.

$$\oint_C \mathbf{F} \cdot d\mathbf{r} = \iint_S (\nabla \times \mathbf{F}) \cdot d\mathbf{S}$$

## Course Philosophy:

"The teaching of calculus ought to have as one of its major aims the total psychological grasp by the student of the processes, techniques, and ideas that will enable him [her] to do something with what he [she] has learned ..." [R. Weinstock, *American Journal of Physics* 31 108-112 (1963)]

Most students leave the traditional calculus sequence with very little sense as to the role that calculus plays in the modern world. Calculus is useful in the social sciences, as well as the biological and physical sciences. Optimization is a key to efficiency in the business world. However, it is not enough to just tell you these things; you must experience them. It is hoped that you will leave this course with the perception that calculus is useful, exciting, and alive in the modern world.

In this class you will be expected to learn calculus at three different levels: Applications, Basics and Computation. These ABC's of the course will be covered through the completion of projects, computer labs and regular homework problems.

This is the last course in the calculus sequence. Hopefully this will be the most interesting of the sequence. As you have seen in your previous calculus classes you will often be called upon to use all of the mathematics, which you have learned up to this point: algebra, trigonometry, geometry, differentiation and integration. You will be asked to solve application problems, which can be just as difficult as the calculus concepts. You will have to think hard to understand the problems in this course and to be able to see how

to apply what you are learning to new situations. Often you will be faced with problems, which are not solved in the text. However, this is true of any real life problem. So, why not get started now.

Success in calculus stems from working at it. Nobody can do well in this course if they just sit passively and watch the instructor scribble some equations on the board. You need to attend every class, pay attention, ask questions, talk to other students and keep up by reading the text and working problems before coming to class. You should plan to study the material two hours a day outside of class.

Calculus does entail a few rules; however, there is no way that you can come away with any understanding of the subject, unless you can see how it is used in the real world. As technology has become more abundant in our society, it seems fitting that preparation for the twenty-first century should entail the use of computers. You will be exposed to technology, to sharpen your skills in critical thinking, and to understand the limits of this technology in order to take full advantage of these computing machines. However, you still need to be able to manipulate algebraic expressions by hand in order to fully internalize the material you are learning.

At the same time, you need to develop communication skills, especially in science and mathematics. Some of the grammatical rules for writing in mathematics are unfamiliar to students. With the abundance of wordprocessors on the market today, professional reports are much easier to prepare. In this course you will have the opportunity to improve your communication skills by writing reports.

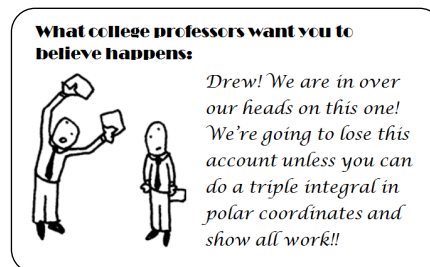
## Group Work:

In this course you will occasionally work with other students to complete a task. For many of you group work will be a new experience. In order to make this experience both productive and enjoyable, we offer the following suggestions:

- ▶ Start the project as soon as it is assigned. Do not put it off until the last minute. Some of the assignments will take time and working in a group may require more time due to scheduling difficulties.
- ▶ Read over the entire assignment, carefully before discussing or completing any part of it.
- ▶ Initially, you may have no idea as to how to get started. Don't panic! Discuss the project with the group and generate some ideas.
- ▶ Projects are not always as straightforward as standard homework assignments. You may need to make some assumptions and later justify these assumptions, indicating how they affect your results.
- ▶ The final report should be thoughtful, well-written and neatly organized. It should summarize your

approach to the problem, present your results and conclusions, and be furnished with full explanations.

- ▶ If you have investigated the project as far as possible and still have questions, or there is a need for clarification of some point, then discuss them with your instructor before writing the report.



## Course Requirements:

**Homework:** Homework assignments will be collected on a regular basis and you will be told when the work is due. There will be a penalty of 10% for each class that it is late. As doing homework is very important for learning the material in this course, it will count as 30% of your grade.

**Projects:** Projects will be an integral part of this course. You will use computers as tools for analysis and exploration. You will report your findings in a format consisting of project reports. This part of the course will count 10% of the grade.

**Attendance:** YOU ARE EXPECTED TO ATTEND ALL OF THE CLASSES! After five excused absences there will be a penalty of 1% for each additional absence from your total grade.

**Exams and Grades:** There will be five 50 minute exams and a final for this course. The exams will cover the basic material in the text. There will be no makeup exams without prior permission. The **tentative dates of the exams** and chapters covered are

Exam	Chapter	Date
1	12	Sep 1
2	13	Sep 15
3	14	Oct 10
4	15	Oct 30
5	16	Nov 21
Final	12-16	Dec 5, 8:00 AM

Your final grade will be based on the following

Hour Exams	40%
Homework	30%
Projects	10%
Final	20%

90-100	A
80-89.5	B
70-79.5	C
60-69.5	D

In some cases borderline grades may be modified by a plus, or a minus, if the instructor determines that such grades are earned.

## Advice for Success:

In order to learn the material in this course and earn a good grade, you need to put in some effort. Do not put off assignments or reading. If you do not understand something, ask the instructor. Come to office hours, use the email, ask knowledgeable students, or go to the library/internet and find supplementary material. The instructor can only cover the basics in class. You are not expected to know the material by only listening to the lectures. You need to work problems and think about what you are doing.

**You are expected to spend a minimum of two hours outside class for every hour you are in class.**

## Web Pages/Email:

This syllabus as well as a variety of other relevant information for this class can will be posted on the internet. You are encouraged to log onto this page at least weekly and send me email. The pages can be found at the following website:

**[people.uncw.edu/hermanr/mat261](http://people.uncw.edu/hermanr/mat261)**

You can email me for hints to homework questions, after working on them. I will try to get back to you with an answer and may post the hints at the web site.

You will also find other useful materials, such as links to tutorials, sample problems, etc. provided by people at other universities. Those proficient with the web may explore and find other sites, which we can add to our resources. So, watch for additions, changes, and announcements for the class.

## First Homework Assignments\*:

Homework problems will be collected and graded. Homework should be neat, fully worked out in detail, in order, and stapled. All homework should be turned in on time for full credit!

HW #	Sec.	Problems	Due
1	12.1	1 3 9 13 16 17 20	8/21
	12.2	4 6 9 11 15 19 20 23 24 35	
2	12.3	2 3 6 11 15 20 36 39 45 56	8/25
	12.4	1 5 8 10 15 22 27 33 36 50	
3	12.5	2 5 7 12 19 24 36 52 71	8/31
	12.6	3 5 8 11 12 21-28 29 31 33	
4	13.1	3 4 8 10 17 28 31 33-35	9/11
	13.2	3 4 9 10 17 18 23 33 35 36 57	
5	13.3	1 2 7 9 17 20 49 51	9/14
	13.4	1 3 5 15 23 37 38	

**\* More problems are posted at the web site.**

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**THIS SYLLABUS IS SUBJECT TO CHANGE!**

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**Academic Honor Code:** All members of UNCW's community are expected to follow the academic Honor Code. Please read the UNCW Honor Code carefully (as covered in the UNCW Student Handbook). Academic dishonesty in any form will not be tolerated in this class. Please be especially familiar with UNC-W's position on plagiarism as outlined in the UNCW Student Handbook. Plagiarism is a form of academic dishonesty in which you take someone else's ideas and represent them as your own.

**Student Disabilities:** UNCW Disability Services supplies information about disability law, documentation procedures and accommodations that can be found at [www.uncw.edu/disability](http://www.uncw.edu/disability). To obtain accommodations the student should first contact Disability Services and present their documentation to the coordinator for review and verification.

**Campus Respect Compact.** UNCW has recently instituted a Respect Compact to affirm our commitment to a civil community, characterized by mutual respect. That Compact will soon be affixed to the wall of each classroom and can be accessed at: <http://uncw.edu/diversity/documents/ApprovedSeahawkRespectCompact8x10.08.09.pdf>.

***Learning takes place outside the classroom.***