# APMA 2120 – Multivariable Calculus
## Fall 2016

**INSTRUCTOR:** Dr. Eduardo Socolovsky
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Office hours: Wed, 4:00 - 6:00 PM
Thurs, 9:30 -10:30 AM
Mon, 2:00 - 3:00 PM

**GRADUATE TAs:** TBA

**APMA WORKSHOP:** Thornton A238
The APMA Workshop schedule can be found on the UVaCollab site "APMA 2120 / All" under "Resources".

**TEXT:** Calculus, Early Transcendentals by Stewart, 8th edition. We will cover Chapters 12-16.

**COURSE DESCRIPTION:**

Have you ever wondered why soap bubbles are spheres? Want to compute the surface area of your breakfast cruller? Or the center of mass of your teddy bear? How can Maxwell's equations, the foundation of classical electrodynamics, and some of the most beautiful equations in all of physics and mathematics, be so simple, yet so powerful? (If you don't believe me, take the opinion of an expert: *"The special theory of relativity owes its origins to Maxwell's equations of the electromagnetic field."* - Albert Einstein)

In many instances, multivariable calculus serves as the fundamental language of physics. It allows us to describe physical quantities in three-dimensional space and also how these quantities vary. Fluid dynamics, solid mechanics and electromagnetism--all of these involve a description of vector and scalar quantities in three dimensions.

You'll need multivariable calculus if you wish to ponder these questions, and this understanding will be yours at the completion of this course. Just swing a stick and you'll probably hit an application of multivariable calculus. In fact, that stick you just swung: you guessed it, we can analyze its motion and impact with said application using multivariable calculus.

**COURSE OBJECTIVES:**

At the end of this course, you will be able to:

- Identify, describe, and create the visual/geometric framework of all multivariable Calculus concepts encountered.
- Apply multivariable calculus to real-world applications.
- Construct a model of a complex system with the aid of multivariable calculus.
- Connect multivariable concepts to other courses, other fields, current events, etc.
- Communicate mathematical problems and their solutions in a professional form.

## WORDS OF ADVICE & ENCOURAGEMENT:

Mathematics can be challenging, but it can also be very rewarding. It's most important to remind yourself that there's a light (not a train) at the end of this tunnel. The learning of math is often a sequence of small failures that ultimately results in bigger successes. But you must learn to live with numerous setbacks and not get frustrated. And this is true for you, for me, and many others: "Do not worry about your difficulties in Mathematics. I can assure you mine are still greater." -Albert Einstein

So how do we fight through the many stumbles, fits, and starts to ultimately succeed? We practice! Mathematics isn't a spectator sport; you must get your hands dirty, working problems. But you must work hard and smart: when you finish working a problem, the work has only begun. Now ask yourself some crucial questions: (1) Do I truly understand the method? (2) How can I verify my work if I don't know the correct answer? (3) What is the significance of this problem? (4) Do I understand what the problem means, and can I describe its meaning in words? (5) Can I make connections to other topics we've studied so far? Don't obsess with getting the right answer, but do obsess with understanding the process, and you will excel (and enjoy) mathematics.

We also need to eliminate "cramming" from our vocabulary. Consider musicians and athletes: do they cram one full day, once a week? No, they typically practice every day. So consider yourself a "mathlete": barring serious injury, you should also be working on math every day. Even when your schedule is packed with projects and midterms in other courses, you should devote at least 30 minutes a day to math.

## HOW WILL YOU AND I EVALUATE YOUR PROGRESS?

### Participation (10%)

Participation will be vital for you to be successful in this class. Here are some participation activities we will be doing throughout the semester.

*Warm-Ups:* You will be asked to complete the assigned readings prior to lecture. The goal of this practice is to prepare you for the work that will be done in class and to help you demonstrate your ability to learn by reading.

*Group Work:* We will be doing group work in class throughout the semester. Working in groups allows you to ask and answer questions of your peers which helps to deepen your understanding of the concepts and applications. It also provides an opportunity for you to develop your mathematical communication skills. At the end of the semester, your lowest group work score will be dropped; there will be NO make-ups.

Rules for Great Group Work:

- Always listen to other people's views and ideas
- Respect other people's views – to disagree politely is okay –but give reasons why
- Make sure everyone has a turn to speak
- Each member takes responsibility for his/her own learning
- Each member of the group is willing to help every other group member who asks for help

**Homework (10%)**

Each week, there will be online assignments administered via WebAssign. The purpose of homework is to gain a better understanding of the material, you may discuss the homework problems with each other and may receive help from others. However, homework is your chance to see if you truly understand the material and can do problems without outside assistance. At the very minimum, you should attempt each problem on your own before seeking help.

**Assessments (80%)**

*Check-for-Understanding (10% total):* There will be check-for-understanding quizzes of approximately 20-minute length every week. The goal of these quizzes is to help you check how well you understand the basic concepts during the previous week. At the end of the semester, your lowest quiz score will be dropped; there will be NO make-ups.

*Midterms (15% each):* Three, fifty-minute midterm exams will be given during class. These will help you and me judge and evaluate the fundamental knowledge and skills you gained throughout the semester.

*Final Exam (25%):* The cumulative final exam will challenge you with a series of problems to assess your ability to integrate concepts and methods from class discussions and your homework assignments. It will provide you with an opportunity to demonstrate everything you have learned during the semester!

**CALCULATORS:** Calculators will not be allowed for any quizzes or exams.

**LEARNING NEEDS:** If you have learning needs that have been evaluated by the Student Disability Access Center (SDAC), I will be happy to accommodate them and help you accordingly. You must, however, provide documentation from SDAC within the first two weeks of the semester or whenever you are evaluated, preferably at least one week before an exam. The contact information for SDAC is sdac@virginia.edu and 243-5180 (phone).

**HONOR CODE:** The Honor Code will be strictly observed in this class. Please remember to pledge each mid-term and the final exam.

**IMPORTANT DATES**: Please be aware of the following dates for **engineering** students. (Students enrolled in the **college** have different deadlines.)

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| Courses Begin: | Tuesday, August 23 |
| Add Deadline: | Tuesday, September 6 |
| Drop Deadline: | Tuesday, October 11 |
| Reading Days (No Classes): | Mon, Oct 3 & Tue, Oct 4 |
| Withdrawal Deadline: | Tuesday, October 18 |
| Courses End: | Tuesday, December 6 |
| Reading Day: | Wednesday, December 7 |
| Final Exams Begin: | Thursday, December 8 |
| Reading Days: | Sun, Dec 11 & Wed, Dec 14 |
| Final Exams End: | Friday, December 16 |

# APMA 2120 – Multivariable Calculus – Fall 2016
# Course Calendar

| *Topics* | *Week* | *Dates* | *Please read:* | *Save these dates:* |
|---|---|---|---|---|
| Vectors and the Geometry of Space | 1 | Aug 23-26 | **Wed:** 12.1<br>**Thurs:** 12.2<br>**Fri:** 12.3 | HW #1<br>Thurs, Sep 1 |
| | 2 | Aug 29-Sep 2 | **Mon:** 12.4<br>**Wed:** 12.5/ Day 1<br>**Fri:** 12.5/ Day 2 | HW #2<br>Thurs, Sep 8 |
| | | **Thursday, Sep 1: Group Work 1 / Quiz 1** (Sections 12.1-12.3) | | |
| Vector Functions | 3 | Sep 5-9 | **Mon:** 12.6<br>**Wed:** 13.1<br>**Fri:** 13.2 | HW #3<br>Thurs, Sep 15 |
| | | **Thursday, Sep 8: Group Work 2 / Quiz 2** (Sections 12.4-12.5) | | |
| | 4 | Sep 12-16 | **Mon:** 13.3/ Day 1<br>**Wed:** 13.3/ Day 2<br>**Fri:** 13.4 | HW #4<br>Thurs, Sep 22 |
| | | **Thursday, Sep 15: Group Work 3 / Quiz 3** (Sections 12.6 & 13.1-13.2) | | |
| Partial Derivatives | 5 | Sep 19-23 | **Mon:** Test 1 Review<br>**Wed:** 14.1<br>**Thurs:** 14.2<br>**Fri:** 14.3 | HW #5<br>Thurs, Sep 29 |
| | | **Monday, Sep 19: Test 1** (Chapters 12 & 13) / 7:00-8:00 pm | | |
| | 6 | Sep 26-30 | **Mon:** 14.4<br>**Wed:** 14.5<br>**Fri:** 14.6 | HW #6<br>Thurs, Oct 6 |
| | | **Thursday, Sep 29: Group Work 4 / Quiz 4** (Sections 14.1-14.3) | | |
| | 7 | Oct 3-4 | **Reading days/NO Class** | |
| | | Oct 5-7 | **Wed:** 14.7/ Day 1<br>**Fri:** 14.7/ Day 2 | HW #7<br>Thurs, Oct 13 |
| | | **Thursday, Oct 6: Group Work 5 / Quiz 5** (Sections 14.4-14.6) | | |
| | 8 | Oct 12-14 | **Mon:** 14.8<br>**Wed:** 15.1<br>**Fri:** 15.2 | HW #8<br>Thurs, Oct 20 |
| | | **Thursday, Oct 13: Group Work 6 / Quiz 6** (Sections 14.7-14.8) | | |
| Multiple Integrals | 9 | Oct 17-21 | **Mon:** 15.3<br>**Wed:** 15.5<br>**Fri:** 15.6 | HW #9<br>Thurs, Oct 27 |
| | | **Thursday, Oct 20: Group Work 7 / Quiz 7** (Sections 15.1-15.3) | | |
| | 10 | Oct 24-28 | **Mon:** Test 2 Review<br>**Wed:** 15.4, 15.6 (Applications)<br>**Thurs:** 15.7<br>**Fri:** 15.8 | HW #10<br>Thurs, Nov 3 |
| | | **Monday, Oct 24: Test 2** (Chapters 14 & 15.1-15.3, 15.5) / 7:00-8:00 pm | | |
| | 11 | Oct 31-Nov 4 | **Mon:** 15.9 | HW #11 |

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| | | | **Wed:** 16.1<br>**Fri:** 16.2 | Thurs, Nov 10 |
| | | **Thursday, Nov 3: Group Work 8 / Quiz 8** (Sections 15.4 & 15.6-15.8) | | |
| Vector Calculus | 12 | Nov 7-11 | **Mon:** 16.3<br>**Wed:** 16.6<br>**Fri:** 16.7/ Day1 | HW #12<br>Thurs, Nov 17 |
| | | **Thursday, Nov 10: Group Work 9 / Quiz 9** (Sections 15.9 & 16.1-16.2) | | |
| | 13 | Nov 14-18 | **Mon:** 16.7/ Day2<br>**Wed:** 16.4<br>**Fri:** 16.5 | HW #13<br>Thurs, Dec 1 |
| | | **Thursday, Nov 17: Group Work 10 / Quiz 10** (Sections 16.3 & 16.6-16.7) | | |
| | 14 | **Monday, Nov 21: Test 3** (Chapters 15.6-15.9, 16.1-16.3, 16.6-16.7) / 7:00-8:00 pm | | |
| | | Nov 21-22 | **Mon:** Test 3 Review<br>**Tues:** NO Class | |
| | | **Wednesday, Nov 23 – Friday, Nov 27: Thanksgiving Recess / NO Class** | | |
| | 15 | Nov 28-Dec 2 | **Mon:** 16.8/ Day1<br>**Wed:** 16.8/ Day2<br>**Fri:** 16.9 | HW #14<br>Thurs, Dec 8 |
| | | **Thursday, Dec 1: Group Work 11 / Quiz 11** (Sections 16.4, 16.5 & 16.8) | | |
| | 16 | Dec 5-6 | **Mon:** Review Session | |
| **Saturday, Dec 10: Final Exam /** 7:00 – 10:00 pm / **Cumulative** | | | | |