MATH 122 A, Spring 2017: Calculus II

Instructor

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Class Meetings

Mondays, Wednesdays, Fridays: 10:50 AM - 11:50 AM in Trexler 374
Thursdays (Lab): 8:30 AM - 10:00 AM in Trexler 372

Office Hours

Mondays, Wednesdays, Fridays: 9:00 AM - 10:30 AM
Tuesdays: 9:00 AM - 10:00 AM, 2:45 PM - 3:30 PM Thursdays: 10:00 AM - 11:30 AM, 2:45 PM - 3:30 PM and by appointment (email me; take advantage of this, as because of chairperson duties, regularly scheduled office hours may occasionally be shortened or canceled)

Course Objectives

This course provides a continuation of the study of calculus. Topics to be studied include more applications of the definite integral, sequences and series and applications of them, and vectors and functions of several variables.

Intended Learning Outcomes

By the end of this course, successful students will be able to:

- apply the theory of differentiation and integration to model and solve real-world problems.
- recognize a differential equation and be able to both solve basic differential equations and discuss what a differential equation tells you about the process it models.
- determine the behavior of infinite series and understand the role of power series and Taylor series in modern mathematics.
- utilize vectors in two-dimensional and higher-dimensional coordinate systems to model graphs and equations, and apply methods of Calculus to these graphs and equations.
- recognize the role of technology in Calculus, understand when it should be used, and be aware of its limitations.

Required Materials

Textbook: *Calculus: Early Transcendental Functions*; Smith and Minton, 4th Edition
Calculator: A calculator with graphing capabilities
Highly Recommended: Laptop with Mathematica installed
Prerequisite: MATH 121 (Calculus I) or the equivalent

Course Grades

The following table lists the weights for the various forms of assessment for this class.

Labs	20%
Exams	80%

A grade scale will be determined after final grades are computed, but will be no worse than the scale given below. Attendance and class participation will be considered when determining marginal grades.

		B+	87-89	C+	77-79	D+	67-69		
A	93-100	B	83-86	C	73-76	D	63-66	F	0-59
A-	90-92	B-	80-82	C-	70-72	D-	60-62		

Reading and Participation

The key to learning a topic in mathematics is participation. We will strive to have an active, rather than passive, classroom environment. The last page of the syllabus is a day-by-day outline of the sections that will be discussed in class. You are **fully** expected to have **read** the upcoming section **before** the class meeting! This does not mean you need to understand everything, but rather you should be familiar with the definitions and concepts from the sections; having read the section will allow you to ask better questions and follow along better in class.

Homework

Homework will be assigned regularly in this class (virtually every class period). At the start of the next class period, some time will be devoted to answering questions from the homework. Note that while homework does not count officially towards your course grade, faithfully completing homework will be key to doing well on the topics associated to testing in this class! Despite not being graded, homework will be collected by the instructor and feedback will be given so that you can learn!

Labs

The mathematics we will be learning has a large number of applications which we will explore during weekly technology labs. Most of our labs will be done using the Mathematica computer algebra system and will last 1.5 hours and typically require a problem set or lab write-up. You can get a free license and download Mathematica from the website https://webapps.roanoke.edu/www/it/mathematica/ anytime (follow the instructions for "Student personally owned machines" on that webpage). Note that the lab portion of this class is run entirely by students that have taken MATH 122 at Roanoke College before; you should treat the students running the lab exactly the same as you would treat the instructor!

Exams

We will be making use of "Mastery-Based Examinations," a system that is probably very different from what you are used to; do not hesitate to ask me questions in class or my office at any time. In the mathematics community many are working with and researching this technique, and one of the best starting sources for understanding can be found at https://mbtmath.wordpress.com. Much of what you'll find on this syllabus is taken from this resource.

Short Description: You only receive credit for answers that demonstrate you completely understand (have mastered) a topic. But, you get many chances to display mastery throughout the semester with no penalty at all for earlier attempts.

Long Description: The course has been boiled down to 18 essential types of questions, or "topics," and your mastery of questions on these topics is assessed through four exams, "topic make-up days," and the final exam. Each problem submitted is graded as either "mastered" or "not mastered" and a grade of "mastered" indicates that you have demonstrated full understanding of the concept being tested and further work on the topic is not necessary. Once you have mastered a problem you need not ever attempt it again on a future exam, including the final exam. There is no penalty whatsoever for multiple attempts taken to achieve mastery.

Exam 1 Topics 1-5
Exam 2 Topics 1-10
Exam 3 Topics 1-14
Exam 4 Topics 1-18 Final Exam Topics 1-18

Your overall exam grade is then determined by the number of questions/topics you have mastered throughout the semester.

Notes on Mastery-Based Examination (in no specific order, credit to Austin Mohr):

- Clear content objectives, students continually know exactly what they need to work on to improve.
- Credit only for eventual mastery. No partial credit.
- Multiple attempts with complete forgiveness.

- A points-based system sets arbitrary deadlines by which time perfection must be attained or else penalties apply
- Perseverance:
  - Points: Try a problem once, maybe twice, hope for the best.
  - Mastery: Keep trying until you succeed (and I know you can).
- Use of feedback on exams:
  - Points: do you agree with the instructor's grading?
  - Mastery: what can I do to fully demonstrate that I understand the concept (improvement!)?
- Reduced Anxiety:
  - Points: every exam has the potential to damage your GPA.
  - Mastery: no one exam can harm your grade.
- Intelligent Test Preparation: You may actually choose to skip problems on a test. Better to achieve mastery on some than to demonstrate mediocrity on all. Given time constraints of the latter tests, most students will only be able to focus on 5-8 problems in 90 minutes.
- Formative Assessment:
  - Points: how many points is this error worth?
  - Mastery: will the student benefit from studying the concept again?
- No longer will any of us have to wonder just what exactly a 7/10 means on a problem compared to an 8/10.
- In most points-based systems, a blank exam question is a heavy blow to a students grade. On the other hand, a student who provides a couple relevant formulas and something resembling the beginning of a solution may receive half credit or more. In the presence of constrained study time, a good strategy is to learn some basics about every test item. Such a student may earn half credit on most items together with a few lucky shots on easier items, which amounts to a passing grade overall. Take a moment to consider whether this experience has adequately prepared the student to apply mathematical thinking to nontrivial problems in the future.

The "broad and superficial" strategy employed above earns no credit under a mastery-based system. Instead, a student who wishes to earn a passing exam grade must fully understand an appreciable subset of the main ideas of the course, and a student wishing to earn an A grade must fully understand most or all of the main ideas of the course. Even if students spend no time studying a particular item, we contend that the experience of pursuing deep understanding on the other items leaves them in a stronger position to engage deeply with the troublesome topic when it is needed in the future. Moreover, depth of understanding is critical to one's ability to apply existing mathematical knowledge in novel domains.

There are four exam days listed on the day-by-day schedule part of this syllabus. On these days, you will have the opportunity to attain mastery in the listed topics (for example, on Exam 3, you can master any topics from 1 through 14). To allow for more opportunities, there are also two pairs of days labeled "Topic Mastery Make-Up Days" for which you can, prior to that Monday morning, contact your instructor with up to 2 topics you wish to attempt mastery; you will then stop by to see either Dr. Minton or Dr. Taylor in their office (Trexler 270C or Trexler 270B, respectively), pick up your questions, and have up to 30 minutes to complete the questions in the MCSP Student Room (Trexler 271).

The exam portion of your course grade will be based on the number of topics mastered; here is a conversion of the number mastered to a percentage for the exam portion of the grade.

Topics Mastered	18	17	16	15	14	13	12	11	10
Exam Percentage	100	96	92	88	84	80	76	72	68
Topics Mastered	9	8	7	6	5	4	3	2	1
Exam Percentage	64	60	56	50	40	30	20	10	0

Final Exam

You will have two final opportunities to achieve mastery on topics for which you did not do so during the semester during the final exam time blocks. Note that one time block is scheduled for the morning of Friday, April 28 (corresponding to the block 9 exam time for which we have lab) and the other is scheduled for the morning on Monday, May 1 (corresponding to the block 3 exam time for which we have class). You may attend either or both of these days. If you have already mastered enough topics to receive an A in the class and wish to skip both days, that is also fine.

MCSP Conversations

The MCSP Department offers a series of discussions that appeal to a broad range of interests related to these fields of study. These co-curricular sessions engage the community to think about ongoing research, novel applications and other issues that face our discipline. Participation in at least **two** of these sessions is mandatory. After attending, submit a one page paper reflecting on the discussion. This should **not** simply be a regurgitation of the content, but rather a personal contemplation of the experience. These reaction papers should be uploaded to Inquire using the appropriate link; failure to complete a required reflection papers will result in your final grade being reduced by 2% for each paper not submitted.

Attendance & Make-Up Work

Attendance is critical to the understanding of the material in the course; it is both required and expected. You will not be allowed to make up any work missed due to an unexcused absence; since testing is done in a mastery-based format, missing an exam day simply means that you can attempt to master the missed topics on a later date (in the event of a valid commitment during a testing day, you may discuss this with the instructor in advance of the exam day and be given an opportunity to master topics near the scheduled exam date).

Other Stuff

The MCSP Department hosts a weekly tea and cookie time for students and faculty; by all means, please feel free to stop by the MCSP Study Lounge (Trexler 271) for tea and cookies (at a time to be announced). Also, our Student Chapter of the Mathematical Association of America (Math Club) is looking for members to have fun hanging out and talking about some fun math topics!

Academic Integrity

Students are expected to adhere to the Academic Integrity policies of Roanoke College. All work submitted for a grade is to be your own work! No electronic devices other than an approved calculator or laptop can be taken out during any class.

During periods of testing, only an approved calculator will be allowed unless otherwise announced. **Cell phones must be turned off during class.**

Topics to Master Here is the list of 18 topics for which you will be seeking mastery during this course. Note that the earlier topics will be available on all exams, while you will have fewer opportunities to master later topics as they occur later in the semester.

1. Differential Equations
2.
3. Applications of Integration
4. Sequences
5. Basic Series Tests
6. Distinguishing Series
7. Convergence of Series (accuracy)
8. Convergence of Series (absolute)
9. Power Series
10. Taylor Series
11. Applications of Taylor Series
12. Vector Calculations
13. Applications of Dot and Cross Product
14. Lines and Planes
15. Graphs in Three Dimensions
16. Projectile Motion
17. Limits and Continuity
18. Gradients
19. Extrema

Course Schedule The last page of this syllabus contains a day-by-day schedule for the course. Due to weather or other unforeseen events, this is a tentative schedule and is subject to change; any changes will be announced in class, sent out through email, and posted as a modified syllabus.

Mon	Jan 16		Introduction to MATH 122 and Mastery-Based Testing
Wed	Jan 18	7.1	Modeling with Differential Equations
Thu	Jan 19		**Lab 1: Differential Equations**
Fri	Jan 20	7.2	Separable Differential Equations
Mon	Jan 23	5.5	Projectile Motion
Wed	Jan 25	5.7	Probability
Thu	Jan 26		**Lab 2: Projectile Motion**
Fri	Jan 27	8.1	Sequences of Real Numbers
Mon	Jan 30	8.2	Infinite Series
Wed	Feb 1	8.3	The Integral Test and Comparison Tests
Thu	Feb 2		**Lab 3: Golden Calculations**
Fri	Feb 3	8.3	The Integral Test and Comparison Tests
Mon	Feb 6	8.4	Alternating Series
Wed	Feb 8		**Review**
Thu	Feb 9		**Exam 1, Topics 1-5**
Fri	Feb 10	8.5	Absolute Convergence and the Ratio Test
Mon	Feb 13	8.5	Absolute Convergence and the Ratio Test
Wed	Feb 15	8.6	Power Series
Thu	Feb 16		**Lab 4: Series**
Fri	Feb 17	8.6	Power Series
Mon	Feb 20	8.7	Taylor Series
Wed	Feb 22	8.7	Taylor Series
Thu	Feb 23		**Lab 5: Math for the Ears**
Fri	Feb 24	8.8	Applications of Taylor Series
Mon	Feb 27		"What is Mathematics" Day
Wed	Mar 1		**Review**
Thu	Mar 2		**Exam 2, Topics 1-10**
Fri	Mar 3	10.1	Vectors in the Plane
			Spring Break
Mon	Mar 13	10.2	Vectors in Space
Wed	Mar 15	10.3	The Dot Product
Thu	Mar 16		**Lab 6: Vectors and Geometry**
Fri	Mar 17	10.4	The Cross Product
Mon	Mar 20	10.5	Lines and Planes in Space **Topic Mastery Make-Up Day (with Tuesday)**
Wed	Mar 22	10.6	Surfaces in Space
Thu	Mar 23		**Lab 7: Curved Cube**
Fri	Mar 24	11.1	Vector-Valued Functions
Mon	Mar 27	11.2	The Calculus of Vector-Valued Functions

Wed	Mar 29		**Review**
Thu	Mar 30		**Exam 3, Topics 1-14**
Fri	Mar 31	11.3	Motion in Space
Mon	Apr 3	12.1	Functions of Several Variables
Wed	Apr 5	12.2	Limits and Continuity
Thu	Apr 6		**Lab 8: Gorilla Golf**
Fri	Apr 7	12.3	Partial Derivatives
Mon	Apr 10	12.4	Tangent Planes and Linear Approximations **Topic Mastery Make-Up Day (with Tuesday)**
Wed	Apr 12	12.6	The Gradient and Directional Derivatives
Thu	Apr 13		**Lab 9: Three-D**
Fri	Apr 14		**No Class: Good Friday**
Mon	Apr 17	12.7	Extrema of Functions of Several Variables
Wed	Apr 19		**Review**
Thu	Apr 20		**Exam 4, Topics 1-18**
Fri	Apr 21	11.4	Curvature
Mon	Apr 24		**Final Review**
Fri	Apr 28		**Final Exam Part 1: 8:30 AM - 11:30 AM, Trexler 372**
Mon	May 1		**Final Exam Part 2: 8:30 AM - 11:30 AM, Trexler 374**