MATH 122 A, Spring 2020: Calculus II

Instructor

Dr. Adam Childers
Trexler Hall 270G
Email: childers@roanoke.edu
Phone: (540) 375-2449
Fax: (540) 375-2561
Web: see Inquire (inquire.roanoke.edu)

Class Meetings

Mondays, Wednesdays, Fridays: 10:50 - 11:50 AM in Trexler 374

Office Hours

Mondays, Wednesdays, Fridays: 12:00-1:00 PM in Trexler 270G and by appointment

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 one variable.

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.
- understand functions of several variables and their applications.
- 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*, by Smith and Minton, 4th Edition
Lab Technology: Laptop with Mathematica installed
Mathematica Free Download: see https://webapps.roanoke.edu/www/it/mathematica/
Calculator: A calculator with graphing capabilities
Prerequisite: MATH 121 (Calculus I) or the equivalent

Commitment Hours

This course expects you to spend at least 12 hours of work each week inside and outside of class.

Course Grades

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

HW/Lab	15%	Mastery Exams	85%

A grade scale will be determined after final grades are computed, but will be no worse than the scale given below:

		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

The key to learning a topic in mathematics is participation. We will strive to have an active, rather than passive, classroom environment. Near the end 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. You should also reread the section *after* class so that you can clarify topics from class and help prepare you further.

Exams

We will be making use of "Mastery-Based Examination," 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 22 essential types of questions, or "topics," and your mastery of questions on these topics is assessed through four mastery testing days, smaller mastery testing opportunities between testing days, and the final exam periods. 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.

Your overall exam grade is then determined by the number of topics you have mastered throughout the semester; see below for more about how the number of topics translates to a grade for the exam portion of the class and what the topics are!

Why such a different examination policy? A typical policy that has four tests on which material on test 1 is not revisited until the final exam promotes a "fixed mindset" mentality and does not encourage growth in learning; allowing multiple attempts to achieve mastery on a single topic is a "growth mindset" – we firmly believe that you can all do this! It may just take some of you a little longer or shorter for certain topics. Rather than thinking "I can't do this" you should be thinking "I can't do this, yet" and work towards getting it done.

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 student's 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 masterybased 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 mastery days listed on the day-by-day schedule part of this syllabus. On these days, you will have the opportunity to attain mastery in any of the topics we have covered up to that date. There are also four mini-mastery days listed on the schedule, and on these days, we will use 30 minutes during a regular class period so that you can attempt mastery in up to two topics of your choice; you must contact the instructor prior 9 AM the day of a mini-mastery attempt with your choice of topics to attempt. Finally, you will have two opportunities during the final exam week in order to achieve mastery.

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	22	21	20	19	18	17	16	15	14	13	12
Exam Percentage	100	97	94	91	88	85	82	79	76	72	68
Topics Mastered	11	10	9	8	7	6	5	4	3	2	1

Exam Percentage	64	60	55	50	45	40	35	30	20	10	0

Homework At the end of each class period during which content is discussed, practice problems will be assigned. It is expected that students work all these problems. To keep you from procrastinating and to measure understanding, an overwhelming majority of class days will begin with a "problem of the day". When you enter the classroom there will be a problem displayed for you to work and turn in. This problem will be due 5 minutes after the start of our class time regardless of when you enter the classroom.

Quizzes There may be written quizzes in this class. They may either be in-class quizzes or takehome quizzes. I may occasionally warn you about an upcoming quiz but you should be prepared to take a quiz on any given day, including lab days. These quizzes will count as a homework assignment.

Final Exam Monday, April 27 from 8:30-11:30AM

Attendance & Make-Up Work Attendance is critical to the understanding of the material in the course; it is both required and expected. Any absence that is not discussed with the instructor prior to the missed class is considered unexcused. When absent, excused or unexcused, you are responsible for all material covered in class. **You will not be allowed to make up any work missed due to an unexcused absence.** Should you miss a class or part of a class, email or talk to me as soon as possible to see if anything can be done to help you catch up.

MCSP Conversation Series The Department of Mathematics, Computer Science and Physics offers a series of discussions that appeal to a broad range of interests related to these fields of study. These co-curricular sessions will engage the community to think about ongoing research, novel applications and other issues that face our discipline. Members of this class are invited be involved with all of these meetings; however participation in **at least two** of these sessions is mandatory. After attending, students will submit a one page paper reflecting on the discussion **within a week of attending the talk**. This should **not** simply be a regurgitation of the content, but rather a personal contemplation of the experience. These reaction papers will be counted as homework and should be uploaded to Inquire using the appropriate link.

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 calculators can be taken out during any class or testing period (this includes cell phones) unless written consent is given by the professor (e.g. Mathematica may be allowed for some tests). Note that looking at or using your cell phone during a test or quiz is considered a violation of Academic Integrity regardless of your purpose or intent in doing so.

Subject Tutoring Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4:00 PM - 9:00 PM, Sunday - Thursday. We are a Level II Internationally Certified Training Center through the College Reading and Learning Association (CRLA). Subject Tutors are highly trained Roanoke College students who offer one-on-one tutorials in a variety of general education and major courses such as: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, INQ 250, and Social Sciences. Tutoring sessions are available in 15, 30, or 45-minute appointments. Feel free to drop by for a quick question or make an appointment at https://libguides.roanoke.edu/subject_tutoring for a longer one-on-one appointment. For questions or concerns, please contact us at 540-3752590 or subject_tutoring@roanoke.edu.

Topic #	Name	Textbook Section
1	Integration: Projectile Motion	5.5
2	Integration: Area Between Curves	5.1
3	Integration: Volume	5.2
4	Integration: Physics	5.6
5	Integration: Probability	5.7
6	Integration: By Parts	6.2
7	Integration: Improper	6.6
8	Multivariable Functions: Basic	12.1
9	Multivariable Functions: Partial Derivatives	12.3
10	Multivariable Functions: Local Extrema	12.7
11	Multivariable Functions: Absolute Extrema	12.7
12	Multivariable Functions: Double Integrals	13.1
13	Multivariable Functions: Area, Volume, Center of Mass	13.2
14	Polar Coordinates: Basic	9.4
15	Polar Coordinates: Double Integrals	13.3
16	Sequences	8.1
17	Series: Core	8.2
18	Series: Ratio Test	8.5
19	Power Series	8.6
20	Taylor Series: Core	8.7
21	Taylor Series: Error	8.7
22	Taylor Series: Applications	8.8

Tentative Schedule

Mon	Jan 13	7.1	Introduction and Projectile Motion
Wed	Jan 15		**No Class**
Fri	Jan 17		**No Class**
Mon	Jan 20	7.1	Projectile Motion
Wed	Jan 22	5.1	Area Between Curves
Fri	Jan 24	5.2	Volume
Mon	Jan 27	5.6	Applications of Integration
Wed	Jan 29	5.6	Applications of Integration
Fri	31		**Mastery Day**
Mon	Feb 3	5.7	Probability
Wed	Feb 5	6.2	Integration by Parts
Fri	Feb 7	6.6	Improper Integrals
Mon	Feb 10	12.1	Functions of Several Variables
Wed	Feb 12	12.3	Partial Derivatives
Fri	Feb 14		**Mastery Day**
Mon	Feb 17	12.7	Extrema of Functions
Wed	Feb 19	12.7, 12.8	Extrema of Functions and Lagrange Multipliers
Fri	Feb 21	13.1	Double Integrals
Mon	Feb 24	13.1	Double Integrals
Wed	Feb 26	13.2	Area, Volume, Center of Mass
Fri	Feb 28		**Mastery Day**
			Spring Break
Mon	Mar 9	13.2	Area, Volume, Center of Mass
Wed	Mar 11	9.4	Polar Coordinates
Fri	Mar 13	13.3	Double Integrals in Polar Coordinates
Mon	Mar 16	8.1	Sequences
Wed	Mar 18	8.2	Series
Fri	Mar 20		**Mastery Day**
Mon	Mar 23	8.2	Series
Wed	Mar 25	8.5	Ratio Test
Fri	Mar 27	8.5	Ratio Test
Mon	Mar 30	8.6	Power Series
Wed	Apr 1	8.7	Taylor Series
Fri	Apr 3		**Mastery Day**
Mon	Apr 6	8.7	Taylor Series
Wed	Apr 8	8.8	Applications of Taylor Series
Fri	Apr 10		**No Class: Good Friday**
Mon	Apr 13	8.8	Applications of Taylor Series
Wed	Apr 15		**Review**
Fri	Apr 17		**Mastery Day**
Mon	Apr 20		**Review**

Mon Apr 27 **Exam Block 8:30 AM – 11:30 AM: Mastery Day** Topics