

# MA 010: Calculus II

Spring 2012 Syllabus

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URL: [http://www.westmont.edu/\\_academics/departments/mathematics/RayRosentrater.html](http://www.westmont.edu/_academics/departments/mathematics/RayRosentrater.html)

Office hours: Tues. 1:30 – 3:00

Thurs. 10:30 – 12:00

Fri. 9:30 – 10:25

Prerequisite:

Calculus I (Math 9) or the equivalent.

Course Objectives:

While students do not always experience the subject in this way, Calculus is the study of various types of approximation and limiting processes. First semester calculus primarily studies limits of functions and the limiting process that results in the derivative. Calculus I also introduces the second important limiting process that results in the integral. In calculus II, we will reinforce and build on these the original ideas and introduce a third type of limiting process: sequences and series. By the end of the course you should be able to:

- explain the Fundamental Theorem of Calculus;
- use the integral in both mathematical and modeling applications;
- explain the concept of convergence for series and be able to test for it;
- use Taylor's Theorem to find power series representations of functions;
- ask mathematical questions and pursue answers;
- express mathematical ideas and questions verbally and in writing.

Often students of mathematics approach the subject as a set of computational techniques to be mastered. While this course does have such a set of techniques, computational mastery is only one of the goals of the course. In fact, computational mastery does not even appear in the list of course goals. Mastery of computational techniques in the absence of an understanding of the basic ideas of calculus is rather like being able to do long division without understanding the purpose and properties of division. Calculators and computers can do the computations better than you can. Understanding is a human activity.

An over-arching goal of this course is to convince students that they are capable of forming significant questions in mathematics and that they are able to make headway in forming answers to those questions. You will be asked to think about what is going on behind the calculations and how the topics of the course fit into the general scheme of mathematics and into the general patterns of human reasoning.

**GE Goals:**

Calculus is an approved course to meet the general education requirement in *Reasoning Abstractly*. A well educated student should be able to engage in critical and analytical reasoning about non-empirical, abstract concepts, issues, theories, objects and structures. The ability to look beyond the particulars of a situation or problem and recognize the common characteristics that fit a particular instance into an overarching structure is a valuable skill. This type of thinking enables one to understand and evaluate abstract arguments and explanations, analyze abstract concepts and solve abstract problems. This skill, in turn, releases one from the need to solve every individual problem from scratch when it is encountered.

By the end of this course you should be able to

1. Identify instances of abstract deductive reasoning about abstract objects or concepts (in the form of arguments, explanations, proofs, analyses, modeling, or processes of problem solving) and distinguish premises from conclusions (or their analogues).
2. Construct an instance of valid deductive reasoning about abstract objects or concepts.

3. Distinguish valid forms of deductive reasoning about abstract objects or concepts from invalid and/or fallacious forms of reasoning.

Calculus is filled with examples of this type of thinking. Almost every calculation one encounters is enabled by connecting a particular problem to a general scheme or principle. Moreover, mathematics as a discipline constantly challenges the user to answer the question: Why does this work? This question forces the diligent user to think abstractly about the principles involved and to supply a general (or abstract) argument that explains the situation.

This semester we will study a historically, theoretically, and practically important example of this phenomenon. For years, even decades, mathematicians developed special formulae and techniques for computing the area under specific curves. Each class of curves required its own special method. Each method was developed by a separate line of thinking. Newton and Leibniz brought the entire project under a single roof via the Fundamental Theorem of Calculus. Not only that, but once the new ideas were understood, they readily extended to a host of other applications including volume, center of gravity, arc length, and motion. We will study this theorem as the highlight of the course. Often students view the Fundamental Theorem as nothing more than an algebraic sort of short cut. However, it is much more important than that. I hope you will appreciate its significance when we study it.

Calculus also satisfies the GE skills requirement *Quantitative and Analytical Reasoning*. The Student Learning Outcomes for this area are:

Students will be able to

1. Make use of mathematical models for physical or social systems  
AND/OR  
Compute and interpret numeric data, summative statistics and/or graphical representations.
2. Reflect on the strengths and weaknesses of particular quantitative models or methods as tools in the natural and social sciences.

There are two general types of analytic models of the world. The statistical model analyzes data to provide descriptions of physical and social phenomenon. These models are then used to make predictions and draw conclusions about the modeled situation. The second type of model begins with general principles and uses algebraic models to predict the behavior of a system. Calculus falls in the second category. Throughout the semester, we will work with a wide range of models of physical and social systems. In some cases, the models are fanciful and simply used to illustrate the methods involved. In other cases, we will work with models that have been developed by scientists in other areas. Calculus is particularly equipped to answer certain types of optimization questions as well as to model interactions between amounts and rates of change. We will have many occasions to deal with such questions through the course of the semester.

**Personal Course Goals:**

You may have your own goals for the course. Please write them here. Also, please let me know what your goals are either by note or email so that I can help you attain them.

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**My Educational Philosophy:**

Mathematics is not a spectator sport. Think about swimming. You could have the best coach in the world, but if all you do is listen to your coach, take careful notes and memorize what was said so that you can repeat it word for word; you will remain a poor swimmer. In order to become a good swimmer, it is essential to practice – and practice long and hard.

My role in this class is much like a coach. I will explain things to you. I will create a helpful environment for learning. I will give you tasks to do. If you take the tasks seriously and do them well, you will improve. If you perform your tasks like an athlete shirking practice, you will not improve, subsequent tasks will become more difficult and you will become frustrated.

James makes a related point. “Do not merely listen to the word, and so deceive yourselves. Do what it says.” (NIV; ch. 1, v. 22)

I occasionally hear students complain that the homework exercises are not like the problems done in class. They “understand everything in class, but the homework is incomprehensible.” In fact, to anyone familiar with the material, the problems worked in class and assigned for homework are essentially identical. This phenomenon is not limited to students. While attending a conference with professional mathematicians, one of the speakers projected a definition on the screen and asked if everyone understood it. “Yes” was the reply. She then put a simple problem on the screen and asked the audience to solve it. More than half of the answers were incorrect. In fact, the audience had not understood the definition! The moral is this: Don’t deceive yourself. Until you are able to use a concept or technique, you do not really understand it. Test your understanding with a problem and then ask more questions. Use my office hours.

Questions are always in order. You should feel free to interrupt at (almost) any time to ask a question. Chances are that if you have the question, so do several others; or maybe they would have had the question if they had been able to formulate it. On the flip side, I will be very free in asking you questions. Do not hesitate to answer even if you are guessing! Many times students are reluctant to answer unless they are certain that they have the correct answer. While it is nice to have the correct answer, typically we learn more from analyzing an incorrect answer. The goal of this course is as much about thinking, being able to conjecture answers, and analyzing arguments for correctness as it is about the answer itself. If the answer were all that mattered, we could look it up in a solutions manual.

Bottom line: I will be active in this class. This includes not only class time, but also times of preparation, consultation, and evaluation. I want you to be active as well: think, question, challenge, propose an alternate way of thinking about things, come to my office hours, and work with your fellow students.

**Text:**     *Single Variable Calculus (Early Transcendentals)*, Jon Rogawski.

**Evaluation:**

Homework	25%
Regular Exams	45% (15% each)
Cumulative Final	30%

1. Homework will be posted on the course web site and is due at the **beginning** of the indicated class meeting. Typically the due date will be two class periods after the relevant topic has been discussed in class. This will allow for a class period during which you can ask questions. You should also make good use of office hours. Homework questions will not be entertained during the class period in which the assignment is due.

Papers submitted before 4:00 p.m. on the due date will be assessed a 25% penalty. After that, late papers will not be accepted. If you will be absent, be sure to send your paper with a friend. Your absence is not sufficient reason for the absence of your homework.

Homework papers should be neat, organized, and clearly presented. There should be no need for arrows on the page directing the reader's attention from one section to another. Rather, problems should be logically laid out with appropriate explanatory and connecting prose and should use sufficient space so that they are easily readable. Equality signs should only link quantities, which are, in fact, equal and, when quantities are equal; this fact should be clearly indicated. Multiple pages should include your name at the top of each page and should be stapled together. Assignments not meeting these standards will have their scores reduced or will be returned ungraded at the grader's discretion.

Answers to application problems should always be interpreted in terms of the original question.

Collaboration on homework is expected and encouraged. Students having difficulty will find answers to some of their questions by working in a group and better students will have the concepts solidified by explaining them to others. Make sure, however, that all members of your group participate and that *everyone* understands each problem by the time that you are finished. It is a great disservice when a weaker student is allowed to be a passive observer to the problem solving process. You cannot learn mathematics by watching others solve problems any more than you can learn to swim by watching others do laps. There will be no reduction in score due to working with others provided the following guidelines are adhered to:

- All students in the group *understand* the solution and are not merely copying solutions.
- *All collaboration is credited.* This will generally take the form of a note at the end of a solution like “the solutions were compared with that of John Martin for verification” or “this solution was developed in collaboration with Jane Smith and Samantha Jones.”

Assignments should include a list of credits for all collaborative work and any help received. This should appear at the top of the first page. **If there was no collaboration a note to that effect should be included.** There will be no reduction in score due to working with others.

2. There will be three section exams. Exam dates and descriptions can be found on the course web page. These exams will test computational skills, but the primary focus will be on conceptual understanding and application of the material.
3. The final exam will be comprehensive but will be weighted more heavily toward the later material of the course. The final exam times and dates are set by the registrar's office and are not subject to modification by the course instructor. Changes can only be made by petition to the Review Committee by December 1. Requests to reschedule to accommodate flight times are not approved. **The final exam for this course is April 30 at 12:00 noon.**

**Absence:** While attendance is expected and absence is unwise, there is no formal penalty for absence. Responsibility is expected. If you are forced to miss class for some reason, you should make arrangements for your homework to be brought to class for you. Your absence is not sufficient reason

for your homework's absence. You should also make arrangements to get notes from the day's lecture. If you know you will be absent on a particular day or for several days, you should make prior arrangements with me to get a list of assignments and to make up the work.

**Calculators:**

While a calculator is not required for this course, there may be occasions when a calculator or spreadsheet software will be useful. You may freely use any type of calculator or software when doing homework. However, the use of calculators such as the TI-89 or TI-92, which perform symbolic algebra and calculus, is not permitted during exams.

**Computers:** Unless you have installed specialized software such as TeX or Scientific Notebook and are proficient in its use, a computer is an ineffective tool for taking calculus notes. If you use relevant software, bring your computer by my office to demonstrate your proficiency. Otherwise, your computer should remain off during class.

**Other Electronic Devices:** Cell phones, iPods and mp3 players should be turned off or set to silent (not vibrate) during class. You are expected to be actively engaging the course material and with your fellow students. This is not possible if you are talking on your cell, texting in your purse, updating your facebook page, tweeting or checking your email under the desk. If you are expecting an important call (your sister is about to give birth or you are awaiting news about the results of your grandmother's surgery), let me know at the beginning of class and we will make accommodations.

**Dishonesty:** Dishonesty of any kind will result in loss of credit for the work involved. Major or repeated infractions will result in dismissal from the course with a grade of F. All instances of dishonesty will be reported to the Provost and Student Life Offices. Collaboration on homework is encouraged, but mere copying of another's work is dishonest and unacceptable. **Give credit for all collaborative work including the comparison of answers.**

**Students with Special Needs:** Students who have been diagnosed with a disability (learning, physical or psychological) are strongly encouraged to contact the Disability Services office as early as possible to discuss appropriate accommodations for this course. Formal accommodations will only be granted for students whose disabilities have been verified by the Disability Services office. These accommodations may be necessary to ensure your full participation and the successful completion of this course. Please contact Sheri Noble, Interim Coordinator of Disability Services (x6186, snoble@westmont.edu) as soon as possible.

**Schedule of Topics:**

Jan.	9	<b>The Integral(s)</b>
	11	The Definite Integral
	13	The Fundamental Theorem of Calculus
	16	<i>MLK Holiday</i>
	17	Integral as Net Change
	18	Substitution
	20	Transcendental Functions
	23	<b>Applications</b>
	25	Area Between Curves
	27	Volume
	30	Density
Feb.	1	Average Value
	3	Work and Energy
	6	<b>Techniques</b>
	8	Parts
	10	Review
	13	<b>Exam I</b> (Through Work & Energy)
	15	Trigonometric Integrals
	17	Trigonometric Substitutions
	20	<i>Presidents Holiday</i>
	22	Improper Integrals
	24	<b>More Applications</b>
	27	Arc Length and Surface Area
	29	Pressure and Force
March	2	Taylor Polynomials
	5	<b>Series</b>
	7	Review
	9	<b>Exam II</b> (Through Pressure and Force)
	12	<i>Spring</i>
	14	<i>Recess</i>
	16	<i>Cont.</i>
	19	Sequences
	21	Infinite Series
	23	Positive Term Series
	26	Absolute Convergence
	28	Ratio and Root Tests
	30	Power Series
April	2	Review
	4	<b>Exam III</b> (Through Taylor Series)
	6	<i>Easter</i>
	9	<i>Recess</i>
	11	Taylor Series
	13	<b>Differential Equations</b>
	16	Exponential Growth
	18	Separation of Variables
	20	$y' = k(y - b)$
	23	Graphical and Numerical Methods
	25	Review
	27	Review
	30	<b>Final Exam, 12:00 noon</b>