

Math 328 – Advanced Calculus

Spring 2013 Syllabus

Class Meetings: PPHAC 101, MWF 1:10-2:20pm

Text: *A Radical Approach to Real Analysis* (2nd edition), by David Bressoud

Author's Website: <http://www.macalester.edu/aratra>

Course Website: <http://math.moravian.edu/hartshorn/328>

Instructor: Kevin Hartshorn

Office Hours: PPHAC 215, Mon 2:30pm - 4:00pm, Thu 10:00am - 12:00pm, *or by appointment*

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Differential calculus is most commonly traced back to Newton's tract on fluxions in 1666. Leibniz published his own work outlining the basic ideas of calculus in 1672. These two men took very different approaches to calculus, and decades of squabbling between them mark the birth of calculus as it has been taught in first-year courses. By the end of the 18th century, many of the problems encountered in a first-year calculus course were dealt with in a manner recognizable to today's students.

Bressoud's text, *A Radical Approach to Real Analysis*, opens with a paper submitted by Joseph Fourier in 1807. This paper provides a mathematical model for the movement of heat through a solid body. It also opened a proverbial can of worms regarding the foundations of calculus. From this revolutionary moment in mathematics, almost 150 years were spent trying to formalize the ideas that had been assumed "obvious" when working with the calculus.

This class will trace the history of analysis through the 19th century. We will explore ideas of continuity, differentiability, infinite series, and other key ideas in analysis. While this is *not* a history of mathematics course, we will follow the text's lead and use history as a guide in studying real analysis. By the end of the course we will have not quite put calculus on a solid, unshakable foundation. Rather, we will have discovered some questions and issues that have been left unresolved (either by us or by history). We shall also gain a deeper appreciation and understanding of the subtleties and power of real analysis.

1 Goals and Objectives

- Expand ability to solve problems in differential calculus,
- Improve on the capacity to both *prove* results and *solve* problems,
- Develop a base of examples illustrating important concepts and results of differential calculus,
- Develop facility in reading and analyzing mathematical text,
- Present clear solutions (not just answers) both written and orally.

2 Course Format

As we encounter new material, the basic format for the class will be:

- Each week, I will provide an agenda of problems to be completed. We will determine day-by-day how many problems will be due in the next class.
- You will have 30-50 minutes to put worked problems on the board. The class will work together through your problem to correct mistakes or improve arguments.
- I will take 15-25 minutes to give a short talk on the next topic of study. The idea of this presentation is not to tell you *how* to complete the next set of problems, but to provide the framework to see how our work fits into the larger narrative of the class.

2.1 Daily Homework

To prepare for each class, you will need to complete several homework problems. Each problem will be scored as follows:

- ..+ Essentially correct, with only the very smallest of errors (100%)
- .. Right idea, but contains at least one significant problem or is incomplete (80%)
- ..- Significant problems with the solution, or little progress toward an answer (50%)
- 0 The problem was not attempted (0%)

At the beginning of class, everyone will grab a felt-tip pen with which to mark up their homework. Once class begins, any marks on your homework must be done with the supplied pen. The score assigned to your problem will be independent of the marks you make with the felt-tip pen. The felt-tip markings are for your own benefit in preparation for completing the weekly homework assignment.

You are encouraged to visit the site <http://www.macalester.edu/aratra> as suggested in the text. Several problems (marked by **M&M**) require the use of *Maple*, and you can find helpful worksheets at the web site.

If you have any homework problems that include a *Maple* demonstration, e-mail the attached *Maple* file to me before the beginning of class. This will allow us to use a single computer account to display the homework problems.

2.2 Engagement and Presentations

At the beginning of each class I will call on volunteers to present the daily homework problems on the board. Our class discussion will then focus on working out the ideas behind the problems and ensuring everyone is able to correct their homework and learn the new material.

For every three class periods that include presentations, I will assign a presentation grade as follows (those who present more than once in a given week will be scored based on the average of their presentation scores).

- 4 Completely correct and clear proof or solution (100%)
- 3 Solution or proof has minor technical flaw, some unclear language, or lacks important details. Essentially correct (75%)
- 2 Partial solution or proof, but significant gap(s) exist (50%)
- 1 Minimal progress or little relevant information that might lead to solution (25%)
- 0 No presentation was given in the given time period

See the class calendar for the schedule of grading periods for presentations. Note that the calendar is subject to change due to class cancellations.

2.3 Weekly homework

Each week, you will be asked to formally write up solutions to several of the daily homework problems. As with the presentations, these problems will be scored on a 4-point scale, but with more exacting criteria:

- 4 Correct and well-written mathematics. (100%)
- 3 A good piece of work, but there are some mathematical errors or writing issues that need to be addressed. (75%)
- 2 There is at least one serious flaw or the writing does not meet acceptable standards. (50%)
- 1 You have clearly worked on the problem, but I cannot see what you are trying to accomplish. (25%)
- 0 No attempt was made on the problem.

These homework problems must be submitted in PDF format and e-mailed to me by Thursday at 11:59pm. Your e-mail should have the subject line *Math 211 Weekly Homework*. To write your homework, I suggest one of the following:

- *Word*: If you decide to use *Word* to complete your work, you need to become acquainted with the Equation Editor feature, as well as the export-to-PDF function. If you are unsure how to appropriately format your document using *Word*, be sure to come to my office with questions.

- *Maple*: You can write text and include proper mathematical notation using *Maple* code. Using the Print command, you should be able to export your file to a PDF format.
- \LaTeX : This is the recommended format. An easy (and free!) way to start using \LaTeX is ShareLaTeX (<https://www.sharelatex.com>). This site will process \LaTeX documents for you, allowing you to download the final PDF document to your computer. Registration is free.

You can also access \LaTeX on campus using the program MicTex.

From time to time through the semester, I will offer tips and short-cuts for creating \LaTeX documents.

I will mark your PDF document directly and e-mail the scored document back to you. If you have a preferred account other than the official Moravian account, be sure to let me know with your first homework submission.

PLEASE NOTE: I will be looking more carefully at the weekly homework for both mathematical accuracy and effective writing. That means that a problem that merited a 4 for your presentation may only merit a 2 or 3 in the written homework if you do not flesh out your proof or write a clear exposition.

Late work: Work submitted after 11:59 Thursday but before 11:59 Saturday will be accepted with a 20% penalty. Work submitted more than 48 hours after the initial deadline will not be accepted.

2.4 Exams

There will be two exams and a final exam for this course. The exams will be on **Monday, February 18** and **Monday, April 8**. The final exam will be on **Wednesday, May 1 at 1:30pm**.

The exams will be based on homework problems as well as the readings from the text. Details on the format of the exams will be provided at a later date.

3 Grading and Assessment

The components of the course will be weighted as shown in the table below.

20%	Daily homework problems
20%	Class presentations
30%	Weekly written homework submissions
15%	Average of two midterms
15%	Final Exam
100%	Total

Generally speaking, your final course grade translates to a letter grade loosely based on the standard 4-point system: generally 85% marks the difference between an “A” and a “B”, 70% marks the difference between a “B” and a “C”, 60% marks the difference between a “C” and a “D”, and any score below 50% is considered failing. Note that these numbers are meant only as a guideline and are subject to change over the course of the semester.

3.1 The retry bonus

On occasion, you may give a presentation or a weekly homework submission for which you clearly tried very hard, but your answer was way off the mark. Perhaps you took your proof in the wrong direction or misunderstood the given conditions.

On such an occasion, you may have the option of reworking the problem and trying again. If you choose to do so, you will not only replace the original score for that problem, but you will get an additional bonus point for that assignment to reflect your willingness to return to the problem.

The retry bonus is only available for problems that I identify after it has been determined that you meet the conditions described above.

4 Attendance and other Issues

4.1 Attendance

While I expect you to attend every session, unavoidable situations will arise during the semester. Thus I will allow each student up to 3 absences, excused or unexcused. Absences beyond this allowance will incur a penalty on your course grade (typically a 5% deduction from the final course grade per class session missed).

Note that there are no “excused” absences. Everyone is given 3 chances before missing class incurs a penalty. Regardless you reason for missing class, it is your responsibility to make up any work that is missed and ensure that work that is due gets to me in a timely manner.

If there are unusual extenuating circumstances requiring you to be absent more than the 3 days allotted, or if you will need to miss class for an extended period of time, be sure to see me as soon as possible to see whether special arrangements can be made.

4.2 Academic Honesty

Everyone is expected to adhere to Moravian College’s Academic Honesty policy, as described in pages 54–59 of the Student Handbook. Two issues of particular note for this course are:

- **Readings and journals:** Your writing assignments should be reflective of your own thoughts and ideas. You may reference conversations you had with other students or with me, but the writing itself should be your own.
- **Homework problems:** Mathematics is a collaborative effort. You are welcome and encouraged to work together on difficult homework problems. Every person is responsible for turning in their own copy of the homework, but encourage you to work together in solving homework problems.

4.3 Final reminders and disclaimers

- *Visit my office!* I would love to hear feedback about which aspects of the course are or are not going well. You have a great deal of power to determine the path this class takes – take advantage of it.
You can also reach me by e-mail (hartshorn@math.moravian.edu).
- This syllabus is subject to change through the semester. The most recent version of the syllabus can be found at <http://www.math.moravian.edu/hartshorn/328/>.
- Final determination of your course grade is subject to my discretion as professor of the course.
- Students who wish to request accommodations in this class for a disability should contact Elaine Mara, assistant director of learning services for academic and disability support at 1307 Main Street, or by calling 610-861-1510. Accommodations cannot be provided until authorization is received from the Academic Support Center.