Math 328 – Advanced Calculus

Spring 2008 Syllabus

Class Meetings: PPHAC 335, MWF 12:50-2:00pm
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/math328`

Instructor: Kevin Hartshorn
Office Hours: PPHAC 215, TuW 2:15pm - 3:30pm, Th 1:00pm - 2:00pm, *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 17th 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 failed to 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

- **Modelling and Problem-solving**
  - Expand ability to solve problems in differential calculus,
  - Improve on the capacity to both *prove* results and *solve* problems,
- **Knowledge**
  - Develop a base of examples illustrating important concepts and results of differential calculus,
  - Recognize the role of analysis in the development of modern mathematics,
- **Communication**
  - Develop facility in reading and analyzing mathematical text,
  - Present clear solutions (not just answers) both written and orally.

2 Course Format

2.1 Reflection and Engagement

Much of what we learn in this class will be from direct engagement with the text. To help focus our efforts in understanding the material, regular writing assignments will be given. Some will be based on the readings for the day, some will be based on the class discussion.

For each writing assignment, you will get a 0 (no submission), ✓− (late or inadequate submission), ✓ (acceptable submission), or ✓+ (exceptionally insightful submission). By default, you can expect a ✓ for each assignment, reflecting that you have met the expectations for reading and reflecting on the text. As grades, these marks translate to:

✓+	100%
✓	80%
✓−	50%
0	0%

Writing assignments are generally expected to be approximately 1 page in length.

2.2 Homework problems

Written homework

Homework will be due once per week. Homework is expected to be neat, organized, and clearly showing all work. You are more than welcome to type your response, though a (neatly) hand-written response is also acceptable. All solutions should be written in complete sentences and clearly indicate both the problem and the logical structure of the solution.

Oral presentations

In addition, everyone will be asked to regularly present homework problems to the class. The class will then help to ensure that the problem is correct and fully justified. I will not tell you if it is "right" or "wrong," but will help to moderate class discussion. Presentations will be assessed based on clarity and exposition.

Generally, homework problems will be presented on Monday in class, and written solutions will be due Wednesday in class. Thus the class can work together to ensure that everyone understands the problems for the week.

Technology

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.

You may use *Maple* to submit your homework (using the text features of the application to annotate your response). Homework assignments completed with *Maple*, TEX, or *Word* may be submitted by e-mail.

2.3 Paper Presentations

While the focus of the book is on mathematics of the 1800's, it is helpful to read about current advances in analysis. Thus everyone will be asked to read and present two papers over the course of the semester.

Assessment of the presentations will be based on the degree of difficulty of the article, the clarity of you presentation, and your mastery of the material in the article. By default, presentations are given in class. However, students who present their paper at an epsilon talk will get extra credit for the presentation.

2.4 Exams

There will be two in-class exams, one in-class "mini-exam", and a final exam for this course. The "mini-exam" will take place on **Wednesday, February 4**. The in-class exams will be on **Friday, February 27** and **Wednesday, April 8** The final exam will be on **Tuesday, May 5 at 1:00pm**.

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.

15%	Class Engagement (regular writing assignments)
15%	Written homework submissions
10%	In-class presentation of homework problems
15%	Paper presentations (average from two presentations)
5%	Mini-midterm
10%	First Midterm
10%	Second Midterm
20%	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.

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, but sure to see me as soon as possible to see whether special arrangements can be made.

4.2 Special date

On Friday, February 20, David Bressoud will be on campus to give a talk on the history of mathematics. Everyone from the class is expected to attend, and I will ask for a short written response to the talk on Monday, February 23.

The talk is scheduled for 3:50, and will last approximately 50 minutes. If you cannot make it to this talk, please see me as soon as possible so that alternate arrangements can be made.

4.3 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.

4.4 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/math328/.

- Final determination of your course grade is subject to my discretion as professor of the course.