MATH 301 Introduction to Mathematical Analysis I
Section 0201 Fall 2014

- Instructor: Dr. Jinglai Shen
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- Lectures: Tue and Thu, 12:30–2:15 pm, at SOND 111
- Office hours: Tue and Thu, 2:30 pm–3:30 pm or by appointment
- Course web-page: http://www.math.umbc.edu/~shenj
- Prerequisites: Math 142 or 152 and Math 221 (CMSC 203 recommended but not required)
- Textbook: *Introduction to Real Analysis* by Robert B. Bartle and Donald R. Sherbert, 4th Edition, John Wiley & Sons, Inc., 2011
- Important dates:
  - No class on Nov. 27 (Thanksgiving Day)
  - Last class: Tue, Dec. 9
  - Final Exam: Thu, Dec. 11

Course Description and Objectives This course is concerned with fundamental properties of real numbers and functions of a real variable using analytic techniques. Typical concepts include sequences, limits, continuity, and differentiation. These concepts form a foundation of calculus and play an extremely important role in both pure and applied mathematics.

This course has two major goals:

- learn the mathematical foundations of real numbers and basic analytic properties of functions of a real variable;
- learn how to read, construct, and write rigorous mathematical proofs.

The topics of this course may overlap with those in calculus courses your have taken before, e.g., sequences and limits. However, this class emphasizes on a rigorous mathematical reasoning based upon well accepted assumptions (or axioms) rather than on computation. The techniques and skills of rigorous proofs and mathematical knowledge in this class will prepare you for higher-level math courses and will benefit you in various areas of mathematics, such as topology, geometry, differential equations, scientific computing, and optimization.

We will cover most of Chapters 1–6 and Appendix A of the textbook. Specific topics are:

- Introduction, Logic and Proofs (Appendix A)
- Preliminaries (Chapter 1)
  - Sets and functions, Induction and finite/infinite sets ($\S 1.1 - 1.3$)
- Real Numbers (Chapter 2)
  - Algebraic and order properties, absolute value and real line ($\S 2.1 - 2.2$)
  - Completeness property and its applications ($\S 2.3 - 2.4$)
- Sequences (Chapter 3)
  - Sequences and limits, monotone sequences ($\S 3.1 - 3.3$)
  - Subsequences and Bolzano-Weierstrass Theorem ($\S 3.4$)
  - Cauchy criterion, properly divergent sequences ($\S 3.5 - 3.6$)
- Limits (Chapter 4)
  - Limits of functions, limit theorems ($\S 4.1 - 4.2$)
- Continuous Functions (Chapter 5)
  - Continuous functions ($\S 5.1 - 5.2$)
  - Continuous functions on intervals, uniform continuity ($\S 5.3 - 5.4$)
- Differentiation (Chapter 6)

Please note that these topics are subject to change, depending on class progress.

Homework Weekly homework will be assigned. Homework is usually collected in Tuesday's class unless a due date change is announced. *No late homework will be accepted.* Please present your answers neatly and show all your work; answers without supporting work may not receive full credit. And please staple your homework if it has multiple pages.

Exams and Quizzes There will be two (2) mid-term exams, one (1) final exam, and two (2) in-class quizzes. Each mid-term exam mainly focuses on topics covered in the month before the exam, but the final exam will be comprehensive. A quiz will consist of a few proofs that cover materials from previous weeks of each quiz. Please be alerted that calculators and other computing devices are *not* allowed for quizzes, mid-term exams and final exam.

Grading Policy The grading scheme is as follows:

- homework: 20%
- quizzes: 15%
- mid-term exams: 40% (20% for each)
- final exam: 25% (the final is comprehensive)

The letter grade will be computed based upon the numerical grade:

$A : \geq 90; \quad B : 89 - 80; \quad C : 79 - 65; \quad D : 64 - 50; \quad F :< 50$

Academic Integrity

- The UMBC Academic Integrity Statement:

  "*By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, or the UMBC Policies section of the UMBC Directory [or for graduate courses, the Graduate School website]*".

- All work in a homework, a quiz or an exam must be your own; collaborating on a quiz or an exam is *not* permitted. Discussions with other students on homework problems are allowed, but you should present your own work in the final turn-in; simply copying other people's work is a violation of UMBC's academic integrity code.

- If you wish to contest a graded exam/quiz, you must make an appeal within *one week* of the return date to the class. All appeals should be made in writing to the instructor with a signed and dated note on the exam or quiz. End of the semester appeals for earlier exams or quizzes will be ignored.

- Make-up tests: if you must miss an exam due to a prior obligation, you must speak to the instructor *in advance* of the exam. If you must miss an exam due to an unforseen but valid reason (e.g. illness), you must submit a written excuse. Failing to do so may result in loss of substantial points in your make-up.

Suggestions While intuitive thinking is important in analysis, this course focuses more on reading and writing formal proofs, which could be challenging for many beginners. In most parts of this course, the challenge does not come from comprehending mathematical results, which may seem intuitive and straightforward at the first glance, but rather from establishing logically sound arguments (known as proofs) from given conditions (e.g., axioms and/or definitions) and presenting these arguments formally. Please be prepared to rely more on logic instead intuition in this class.

The course will provide you ample opportunities to develop deductive thinking and analyzing ability as well as formal proof writing capability. Here are a few suggestions that will help you grasp materials efficiently:

- Be critical about your results; make sure that each step in your argument is well justified by given conditions. Always ask more why's.
- Read the scheduled materials before going to class. If you have difficulty in understanding any concepts or results, bring them to the class.
- Review notes and the textbook before doing homework. Though discussions are allowed for homework problems, try your best to solve them with your own effort.
- If you have already done your best but sill have questions about materials, do not put them aside. Either see the instructor in office hours or get helps from other sources right away. If you are left behind at certain point, it could take you much more time and effort to catch up.