

## **Program Cover Document - MAT 310: Real Analysis**

### **I: Basic Course Information**

MAT 310 is a junior/senior level course that serves as an introduction to Real Analysis. Analysis is a broad field of mathematics that is based on concepts students have studied on a very elementary level in calculus. Real Analysis is the branch of this discipline that considers properties and behavior of real-valued functions of a real variable.

The course will be scheduled for two 80-minute lecture periods. Its prerequisites are MAT 200 and MAT 229. 1 course unit.

### **II: Learning Goals**

The choice of content for MAT 310 serves two goals. First, many concepts studied in MAT 310 are first studied in more elementary calculus courses such as MAT 127, 128, and 229. The more rigorous treatment of those concepts in Real Analysis will give the student a clear understanding of the definition of differentiation and integration, and familiarize the student with the logical unfolding of the fundamental principles of calculus, from a mature point of view. Secondly, a majority of MAT 310 students are mathematics majors or mathematics education majors. The study of Real Analysis will help the student acquire solid background knowledge and maturity that will enable him or her to become an inspiring teacher of calculus and other advanced mathematics, and prepare the student who wishes to continue graduate study in mathematics for advanced work in mathematical analysis.

### **III. Learning Activities**

The specific choice of learning activities will depend upon the instructor, but it is expected that they will consist of a combination of lectures, readings, group work, individual homework, student presentation, tests, and exams. Outside of class, students are expected to do a significant amount of individual and group homework to achieve the learning goals. By giving students a multitude of ways to learn and do mathematics, the learning activities promote a deeper understanding of the concepts of Real Analysis and contribute to the learning goals of the specializations in the Department of Mathematics and Statistics.

### **IV. Student Assessment**

It is expected that students will show competence with the ideas of real analysis and thorough understanding of its concepts, will exhibit an ability to think rigorously and abstractly, and will demonstrate an improved ability to read, write, and understand proofs. The specific assessment plan will be at the instructor's discretion but should be primarily based upon a combination of exams, presentations, and homework. Given the particularly challenging material of abstract concepts and proofs, it is important that students receive regular feedback on their work.

## **V. List of Major Course Topics**

The following list of topics will be covered in the course.

1. Introducing Real Numbers
2. Completeness and consequences of Completeness
3. Neighborhoods, Open and Closed Sets
4. Sequences and Series\*\*
5. Functional Limits and Continuity
6. Uniform Continuity
7. Derivatives
8. Riemann Integral, Fundamental Theorem of Calculus

\*\* as time permits

*Approved 4/8/15*

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**Textbook:** *Steven Abbott, Understanding Analysis*, Springer

Supplemental text (optional): *Patrick Fitzpatrick, Advanced Calculus*, 2<sup>nd</sup> edition

**Office Hours: Monday: 8:30-9:30am, Wednesday 4:00-5:00, Thursday 3:30-4:30**

### **Course Description**

A logical development of mathematical analysis for functions of a single real variable. Topics include order, completeness, sequences, series, limits of functions, basic topology of the reals, differentiation, integration. Prerequisites: MAT 229 and MAT 200. 1 course unit.

**Fourth hour:** The fourth hour is used for deepening students' understanding of the material and for sharpening their problem solving skills through an additional class meeting, a group meeting, or individual work.

### **Learning Goals**

- i) To explore the nature of the infinite.
- ii) To improve your problem-solving and proof writing skills.
- iii) To understand why an intuitive understanding of calculus is insufficient as a foundation for building more complicated and powerful mathematical tools in analysis.
- iv) To enjoy the payoff of analytical rigor and abstraction by studying questions that gives analysis its inherent fascination.
- iv) To acquire a thorough understanding of the concept of a limit in many different settings.

### **Learning Activities and Assessment**

#### **Homework**

Weekly problem sets will be assigned to work on in groups. The solutions must be both mathematically correct and properly written in English to earn credit. You may consult other real analysis texts in the library. However any relevant text or other source that you use should be acknowledged appropriately in your write-up. Be sure that you understand what you are writing down. You should not consult the internet to find solutions to homework problems. **Finding the solution on the internet and copying it down is not considered a useful way to learn mathematics and I will give no credit for it.** These group homework assignments will be collected and graded and/or a homework quiz will be given over similar problems in class.

In addition, homework assignments may contain challenge questions. These must be solved individually, you may only ask clarification questions from others. You need to solve three of these correctly by the end of the semester. Additional solutions will earn extra credit up to a max 2% of your semester grade.

### **Examinations**

There will be two mid-semester tests, a few quizzes and a final exam in addition to the homework quizzes. Makeup exams will only be given in extraordinary circumstances supported by written evidence, such as a doctor's note or funeral announcement, and only when the request has been made in advance of the exam. The final examination will be cumulative.

### **Grading**

Homework: 20% (including homework quizzes and challenge questions)

Quizzes: 15%

Test 1: 20%

Test 2: 20%

Final exam: 25%

### **Homework Grading**

Most homework problems will be graded on a 3-point scale, according to the rubric below. Occasionally, you will have more intricate 6-point questions that will be graded on a 0-6 scale.

3 points Work is completely accurate, essentially perfect. Ideas are fully developed. Work is neat and easy to read. Complete sentences are used.

2 points Work is good, on the right track, but development of ideas is incomplete. Work is hard to read or disorganised.

1 point Work is sketchy, with some correct ideas, but mostly on the wrong track. Work is messy or illegible.

0 points Work is minimal or non-existent. No explanations are given. Answer is completely incorrect.

I normally give some credit for completeness and only grade a handful of problems for correctness.

Each group will hand in one final copy. The final copy has to bear witness to the collective effort that lead to the published product, each person in the group has to write

part of the homework. I will assume that you have discussed these problems and peer reviewed the work before submitting, so the entire group will receive the same grade.

**Absence/attendance:** Any missed quiz or test will be given a grade of zero unless a prior arrangement is made with me. Attendance and class participation are expected in this course and may be used to adjust your grade if your grade is on the border line. Details of TCNJ's attendance policy can be found at <http://www.tcnj.edu/~recreg/policies/attendance.html>.

**Academic integrity:** Students are expected to know the college's policy on academic integrity, which can be found at <http://www.tcnj.edu/~academic/policy/integrity.html>. Any violation of academic integrity will be dealt based on the academic integrity policy of the college.

**Americans with Disabilities Act (ADA) Policy:**

Any student who has a documented disability and is in need of academic accommodations should notify me and contact the Office of Differing Abilities (609-771-2571) <http://differingabilities.pages.tcnj.edu>. Accommodations are individualized and in accordance with section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1992. TCNJ Americans with Disabilities Act (ADA) policy is available at <http://policies.tcnj.edu/policies/digest.php?docId=8082> .