MATH 301/571 – Introduction to Mathematical Analysis
Fall 2022-23 Instructor: Gökhan Göğüş

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We learn already in high school that integration plays a central role in mathematics and physics. One encounters usual Riemann integrals in the notions of area or volume, when solving a differential equation, in the fundamental theorem of calculus, in Stokes' theorem, or in classical and quantum mechanics. One purpose of this course is to introduce more advanced tools and notions of Mathematics such as metric spaces, uniform convergence of sequence of functions and their relation with differentiation and integration.

Lectures. Monday 8:40-9:30 FENS L045, Thursday 10:40-12:30, FENS L045
Recitations. W 10.40-11.30 FENS L045

Textbook(**see SuCourse/Announcements for a link**)
Michael C. Reed, Fundamental Ideas of Analysis, John Wiley & Sons, Inc., 1998. We will cover the first 6 chapters, we will skip some sections. Detailed weekly schedule is at the end of the syllabus.

Recommended Reading
Walter Rudin, Principles of mathematical analysis. 3rd ed. *McGraw-Hill Book Co., New York-Auckland-Düsseldorf,* 1976
Chapters 1-7. This is an advanced book designed for Mathematics majors. You can benefit from this book if you want to learn more proof-theoretic approach of the subject.

E. Çınlar, R. J. Panderbei, Mathematical Methods of Engineering Analysis. *Lecture notes for a course at Princeton University,* 2000. These are the lecture notes of a one semester course for engineers given at Princeton University.

Course Outline
Sequences, series. Riemann integral. Continuity. Metric spaces. Contraction principle. Compactness. Uniform continuity. Uniform convergence.

Grading
There will be one midterm, four homework, one final exam. Best three homework grades will be taken.

Homework		30%
Midterm		30%
Final		40%

Grading scale: **90-100 A, 86-89 A-, 81-85 B+, 76-80 B, 70-75 B-, 65-69 C+, 61-64 C, 56-60 C-, 52-55 D+, 48-51 D, less or equal 47 F. Plus and minus grades will be given at my discretion.**

Homework. Homework assignments are based on the lectures and will be posted on the SU-course website sometime on Wednesday. That assignment will be due in two week on Wednesday at the beginning of the lecture. You are encouraged to do your homework in groups. You are required, however, to write up your homework on your own. Homework is an essential educational part of this course. Your work will be graded mostly on your ability to work problems on exams. You cannot work problems on midterm exams if you have not practiced the techniques within the homework problems. If you misuse homework by not doing it yourself, or not checking that you can solve a problem on your own after having been shown how to do it, then your exam scores and corresponding grade will reflect this.

The date of the midterm is below. See the last page for the content.
Midterm December 8, Thursday, 10.40-12.30 (lecture time)

Attendance: Attendance will be taken both in lectures and in recitations during the semester. You are expected to attend every class. If you miss a class, it is your responsibility to obtain a copy of the lecture notes from another student. You are also responsible for any announcements about changes to the course schedule, the exam schedule, or the course requirements made during that class.

Academic Honesty
The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Cheating hurts our community by undermining academic integrity, creating mistrust, and fostering unfair competition. The university will punish cheaters with failure on an assignment, failure in a course, permanent transcript notation, suspension, and/or expulsion. Violations can include cheating on exams, plagiarism, reuse of assignments without permission, improper use of the Internet and electronic devices unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Ignorance of these rules is not an excuse.
In this course, as in many math courses, working in groups to study particular problems and discuss theory is strongly encouraged. Your ability to talk mathematics is of particular importance to your general understanding of mathematics. You should collaborate with other students in this course on the general construction of homework assignment problems. However, you must write up the solutions to these homework problems individually and separately. If there is any question as to what this statement means, please see the professor or the recitation instructor.
For more information, see the guide on the SU website (http://mysu.sabanciuniv.edu/yonerge/Akademik_durustluk/E-Investigation.html)

Goals. By the end of this course, students should be able to:
(a) Define the notion of a metric space
(b) Use the notions of basic topology to classify the open, closed, connected or compact subsets of the Euclidean space
(c) Define the notion of a continuous function
(d) Define the notion of a differentiable function
(e) Use the notion of uniform convergence of series of functions.

Course Schedule: *Roughly these topics will be covered in each week.*

Dates	**Section Readings (weekly)**	**W & M**
Week 1	Ch. 1, Structure of real numbers R	
Week 2	Ch. 2, Sequences: Convergence and Cauchy sequences	
Week 3	Ch. 2, Sequences: Bolzano-Weierstrass	
Week 4	Ch 6.1, Limsup and Liminf	**H1**
Week 5	Ch 6.2, Series	
Week 6	Ch. 3, Riemann Integral: Continuity, Riemann Integral	
Week 7	Ch. 3, Improper integrals	**H2**
Week 8	Ch 4, Differentiation, fundamental theorem of Calculus	
Week 9	Ch 4, Taylor's theorem, inverse functions	
Week 10	Ch 5, Uniform convergence	**M**
Week 11	Ch 5, Limit theorems, sup norm	**H3**
Week 12	Ch 5, Metric spaces	
Week 13	Ch 5, Contraction mapping principle, Ch 6.3, Weierstrass M-test	
Week 14		**H4**

W = Workshop
M = Midterm

11-12 Oct 2022 Add-drop period
14 Nov-9 Dec 2022 Withdrawal

Content of the exams. Roughly the following topics will be the content of the exams.

Midterm I. December 8, Thursday, 10.40-12.30 (lecture time)
Ch 1 The real number system, sets and functions, cardinality.
Ch 2 Convergence, limit theorems, Cauchy sequences, sup and inf, Bolzano-Weierstrass.
Ch 6.1 & 6.2 Limsup, liminf, series
Ch 3 Continuity, continuous functions on closed intervals, Riemann integral, discontinuities, improper integrals.
Ch 4 Differentiable functions, Fundamental theorem of Calculus, Taylor's theorem, Inverse functions.

Final. All topics above plus the following
Ch 5 Pointwise and uniform convergence, Limit theorems, sup norm, metric spaces, contraction principle
Ch 6.3 Weierstrass M-test