Class Meeting Location: SOS Z17
Class Meeting Times: MN B1, WE B1

Instructor: BURAK ÖZBAĞCI
Office Hours: Mon-Wed 16:00-17:00
Office Location: SCI 153
Office Phone: 1731
Email: bozbagci@ku.edu.tr
Web Address:

Number of Credits: 3
ETC Credit:
Prerequisites: MATH. 103 or consent of the instructor
Language: English

Assistant

<table>
<thead>
<tr>
<th>TA/RA/Lab Assistant Name</th>
<th>Email</th>
<th>Office Hours</th>
<th>Office Location</th>
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<tbody>
<tr>
<td>SÜMEYRA SAKALLI</td>
<td><a href="mailto:ssakalli@ku.edu.tr">ssakalli@ku.edu.tr</a></td>
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Course Description

Real numbers and the completeness axiom; Real sequences, series, and their convergence; Real-valued functions of a real variable: continuity, uniform continuity, and differentiability; Euclidean Space: vector and inner product space structures, convergence of sequences, open, closed, compact, and connected subsets; Functions mapping between Euclidean spaces: Continuity, differentiability, the inverse and implicit function theorems.

Course Objectives

The objective of this class is to be able to write rigorous mathematical proofs for basic theorems in multi-variable calculus involving the fundamental tools such as continuity and differentiability. This class is essential for any student majoring in mathematics.

Learning Outcomes

The student is expected to learn about the basic principles of multi-variable calculus with proofs. This class is a bridge between freshman calculus and more advanced real analysis.

Teaching Methods

The method of instruction is lecturing on the material following the textbook. The students are encouraged to participate in the discussion by asking questions.

Course Contents

<table>
<thead>
<tr>
<th>Session Number</th>
<th>Starting Date</th>
<th>Topics</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>06/02/2012</td>
<td>The completeness axiom, Archimedean property, rationals are dense</td>
</tr>
<tr>
<td>2</td>
<td>08/02/2012</td>
<td>Triangle inequality, binomial formula, geometric sum formula</td>
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<td>3</td>
<td>13/02/2012</td>
<td>Convergence of a sequence, the sum, product and quotient of convergent sequences</td>
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<tr>
<td>4</td>
<td>15/02/2012</td>
<td>Boundedness of a convergent sequence, monotone convergence theorem</td>
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<tr>
<td>5</td>
<td>20/02/2012</td>
<td>Every sequence has a monotone subsequence, Bolzano-Weierstrass Thm: Every bounded sequence has a convergent subsequence.</td>
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<tr>
<td>6</td>
<td>22/02/2012</td>
<td>Nested interval thm, sequential compactness theorem: A closed and bounded set is sequentially compact.</td>
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<tr>
<td>7</td>
<td>27/02/2012</td>
<td>Quiz 1 covering chapters 1,2</td>
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<tr>
<td>8</td>
<td>29/02/2012</td>
<td>Introduction to continuous functions, extreme value thm, intermediate value thm</td>
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</table>
Uniform continuity on a closed and bounded interval

Equivalent definitions of continuity

Midterm 1 covering chapters 1, 2, 3

Solutions to Midterm 1

A criterion for continuity of monotone functions, continuity of inverse functions

Limits of functions

Derivatives of polynomials

Derivatives of inverse functions

Chain rule

Mean Value Theorem

Higher order derivatives, Second derivative test for local minimizers and maximizers

Cauchy criterion for convergent sequences, infinite series

n-dimensional Euclidean space, scalar product of vectors, Cauchy-Schwarz inequality, triangle inequality

Convergence of sequences in $\mathbb{R}^n$, componentwise convergence criterion, interior of a set, open set, closed set

Unions and intersections of open sets/closed sets, boundary points, exterior points.

Continuity of functions from $\mathbb{R}^n$ to $\mathbb{R}^m$, basic properties of continuous functions, componentwise continuity criterion

The epsilon-delta criterion for continuous functions, inverse images of open sets under continuous functions

Sequential compactness, extreme value theorem, uniform continuity

Pathwise connectedness and connectedness

### Assessment Methods

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Final Grade, %</th>
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<tbody>
<tr>
<td>Quiz</td>
<td>Quiz 1</td>
<td>10</td>
</tr>
<tr>
<td>Midterm Test</td>
<td>Midterm 1</td>
<td>20</td>
</tr>
<tr>
<td>Quiz</td>
<td>Quiz 2</td>
<td>10</td>
</tr>
<tr>
<td>Clinical Assignments</td>
<td>Participation</td>
<td>20</td>
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<tr>
<td>Final Exam</td>
<td>Final</td>
<td>40</td>
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<tr>
<td><strong>Total</strong></td>
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### Workload Breakdown

N/A

### Sources

**Required TextBooks**


### Other

Attendance: If a student does not show up for more than 6 classes then he/she will automatically get an F grade.

Auditing Students: In order to get an AU, a student must attend at least 20 lectures.

### Academic Dishonesty

N/A