



## Course Information

<b>Course Code</b>	2360313
<b>Course Section</b>	1
<b>Course Title</b>	METRIC SPACES
<b>Course Credit</b>	4
<b>Course ECTS</b>	7.5
<b>Course Catalog Description</b>	Metric Spaces. Compactness, connectedness, limits and continuity in metric spaces. Sequences and series in metric spaces, complete metric spaces, completion of a metric space. Sequences and series of functions, uniform convergence. Applications: contraction mappings theorem and its applications, Tietze extension theorem, Baire's theorem.
<b>Prerequisites</b>	Students must complete one of the following sets to take this course.

Set	Prerequisites
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1	2360214
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2	2360252
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<b>Schedule</b>	Monday , 15:40 - 17:30, M13 Wednesday, 15:40 - 17:30, - Thursday , 16:40 - 17:30, M13
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## Instructor Information

<b>Name/Title</b>	Assist.Prof.Dr BURAK KAYA
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<b>Office Phone</b>	
<b>Office Hours</b>	TBA

## Course Assistants

<b>Name/Title</b>	Araş.Gör. YUSUF UYAR
<b>Office Address</b>	
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<b>Office Hours</b>	

## Course Objectives

At the end of this course, the student will learn:

- the basic theory of metric spaces and related topological notions in context of functions, sequences, series and series of functions, and
- various important theorems regarding topology of metric spaces and their applications in mathematics

## Course Learning Outcomes

Student, who passed the course satisfactorily will be able to:

- understand the geometry and topology of metric spaces in general,
- recognize the metric spaces that are frequently used in mathematics and build metric spaces in relevant cases,
- use the notions of limit, continuity and convergence in metric spaces in context of functions, sequences and series,
- recognize various properties of metric spaces such as connectedness, compactness, totally boundedness etc., and
- use various fundamental theorems regarding the theory of metric spaces, such as Banach's contraction theorem, Arzela-Ascoli theorem, Tietze extension theorem, Baire's category theorem etc.



## Program Outcomes Matrix

Undergraduate

Program Outcomes	Level of Contribution			
	0	1	2	3
1 Acquires mathematical thinking skills (problem solving, generating ways of thinking, forming correspondence, generalizing etc.) and can use them in related fields.				X
2 Can produce innovative thoughts and products.				X
3 Can design mathematics related problems, devise solution methods and apply them when appropriate.			X	
4 Has a comprehension of mathematical symbols, concepts together with the interactions among them and can express his/her solutions similarly.				X
5 Has a command of Turkish and English languages so that he/she can actively communicate (read, write, listen and speak).			X	
6 Contributes to solving global, environmental and social problems either individually or as being part of a social group.	X			
7 Respects ethical values and rules; applies them in professional and social issues.		X		
8 Can work cooperatively in a team and also individually.		X		
9 Is responsive to life-long learning, improving his/her skills and abilities			X	
10 Comprehends necessity of knowledge, can define it and acquires it; uses knowledge effectively and shares it with others				X

0: No Contribution 1: Little Contribution 2: Partial Contribution 3: Full Contribution

## Instructional Methods

Lectures and recitations will be held in person, in a classical classroom environment.

## Tentative Weekly Outline

Week	Topic	Relevant Reading	Assignments
1	The definition of a metric space and various examples of metric spaces. The definition of a topological space and the topology induced by a metric		
2	Basic topological notions in a metric space and illustration of these notion on various examples of metric spaces		
3	Sequences in a metric space and illustrations of notions of convergence, Cauchyness etc. in various examples of metric spaces		
4	Complete metric spaces and completely metrizable metric spaces. Examples of non-examples of complete metric spaces		



Week	Topic	Relevant Reading	Assignments
5	The notions of continuity, sequential continuity and uniform continuity of functions between metric spaces, and examples		
6	Lipschitz functions, isometries and homeomorphisms between metric spaces, and examples		
7	Products of metric spaces and various product metrics compatible with the product topology, and examples		
8	The construction of the set real numbers as Cauchy completion. The completion of a metric space and its construction.		
9	Compact metric spaces. The notions of compactness, sequential compactness and total boundedness.		
10	Tychonoff's theorem for finitely many factors and the Heine-Borel theorem		
11	Compactness and continuity. Related theorems such as the homeomorphism theorem, the extreme value theorem, the uniform limit theorem, Dini's theorem etc.		
12	Connectedness and arcwise connectedness in a metric space. Connected, disconnected and totally disconnected metric spaces, and examples. Connectedness and continuity, and the intermediate value theorem		
13	Some selected applications: <ul style="list-style-type: none"> <li>Banach's fixed point theorem and Picard's theorem</li> <li>Arzela-Ascoli theorem</li> <li>Tietze extension theorem for metric spaces</li> </ul>		
14	Some selected applications: <ul style="list-style-type: none"> <li>Baire category theorem</li> <li>The existence of nowhere differentiable functions</li> <li>The construction of space filling curves</li> </ul>		

## Course Textbook(s)

We shall be using my lecture notes that will be uploaded to ODTÜ Class throughout semester. The lecture notes will be mainly based on the textbook

- **An Introduction to Real Analysis** by Tosun Terzioğlu that was published by Matematik Vakfi.

That said, you should keep in mind that there will be additional material that is not covered in this textbook and some definitions and proofs may differ from this textbook. For this reason, you are strongly suggested to follow the lecture notes.

## Course Material(s) and Reading(s)

*Material(s)*

Not applicable.

*Reading(s)*

Not applicable.

## Assessment of Student Learning

Assessment	Dates or deadlines
There will be three <b>midterm exams</b> each out of 80 points. Each midterm will have <b>%20 weight</b> in your overall score that is to be used for letter grades. I will use <b>Gradescope</b> to grade your exams, unless you prefer otherwise in which case you should let me know in advance.	TBA
There will be one <b>final exam</b> out of 100 points. The final exam will have <b>%40 weight</b> in your overall score that is to be used for letter grades. I will use <b>Gradescope</b> to grade your exams, unless you prefer otherwise in which case you should let me know in advance.	TBA

## Course Grading

Deliverable	Grade Points
Midterm I	20
Midterm II	20
Midterm III	20
Final Exam	40
<b>Total</b>	<b>100</b>

## Course Policies

### *Class Attendance*

Attendance is **not mandatory**, however, is **strongly suggested** since experience repeatedly shows that the more students attend and actively participate in class, the better they learn and perform.

### *Class Participation*

While class participation is **not formally graded**, it is **highly encouraged** since "mathematics is not a spectator sport" as Pólya once said.

### *Make up for Exams and Assignments*

**No make-ups will be given without an official report.** This policy is non-negotiable. If you are going to miss an exam because of extraordinary conditions, which may not be documented via reports, you should contact me **in advance**.

## Information for Students with Disabilities

Students who experience difficulties due to their disabilities and wish to obtain academic adjustments and/or auxiliary aids must contact ODTU Disability Support Office and/or course instructor and the advisor of students with disabilities at academic departments (for the list: <http://engelsiz.metu.edu.tr/en/advisor-students-disabilities>) as soon as possible. For detailed information, please visit the website of Disability Support Office: <https://engelsiz.metu.edu.tr/en/>

## Academic Honesty

The METU Honour Code is as follows: "Every member of METU community adopts the following honour code as one of the core principles of academic life and strives to develop an academic environment where continuous adherence to this code is promoted. The members of the METU community are reliable, responsible and honourable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."