Tarih: 23 Ağustos 2025 20:47

Department of Mathematics Education / Department of Mathematics and Science Education /

Course Code	Course Name	Teorical	Practice	Laboratory	Credits	ECTS
İMEAE 404	MODELING IN MATHEMATICS TEACHING	2.00	0.00	0.00	2.00	4.00

Course Detail

Course Language	:	Turkish
Qualification Degree	:	Bachelor
Course Type	:	Compulsory
Preconditions	:	Not
Objectives of the Course	:	In this course, mathematical modeling concept and modeling processes, working on different modeling problems, developing modeling problems, learning about classroom modeling applications, designing modeling applications, evaluating modeling problems through different examples are aimed.
Course Contents	:	This course covers mathematical modeling and problem solving; models and modeling process in mathematics teaching; modeling cycle (problem identification, manipulation, estimation and validation), model development steps; model development principles; the application of modeling activities in mathematics classrooms and the role of the teacher; It covers the subjects of preparing mathematical modeling activities and monitoring students' mathematical thinking processes.
Recommended or Required Reading	:	Lecture notes, supplementary resources, smart board or projector, unit cubes, multiplication table, polyomino set, multilink cubes, algebra tiles, pattern blocks, tangram, fraction cards, geometry strip, isometric paper, geometry board, scaled volumes, number balance. Recommended Resources: (1) Lesh, R., & Doerr, H. M. (2003). Beyond constructivism: A models and modelling perspective on mathematics problem solving, Learning, and teaching. Mahwah, NJ: Lawrence Erlbaum Associates, Inc. (2) Ural, A. (2018). Mathematical modelling education. Ankara: Anı Publishing. (3) Dost, Ş. (Ed.). (2019). Modelling activities in mathematics education. Ankara: Pegem Academy Publishing. (4) Bukova Güzel, E. (Ed.). (2021). Mathematical modelling in mathematics education (4th ed.). Ankara: Pegem Academy Publishing. (5) Maaß, J., O'Meara, N., Johnson, P., & O'Donoghue, J. (2020). Mathematical modelling for teachers (Trans. A. Yıldız). Ankara: Vizetek Publishing.
Planned Learning Activities and Teaching Methods	:	This course explores mathematical modeling and problem-solving processes, focusing on the role of models and the modeling process in mathematics education. The course covers key stages of the modeling cycle—problem identification, manipulation, prediction, and validation—while also examining the fundamental steps and principles of model development. Additionally, it delves into the implementation of modeling activities in mathematics classrooms, the teacher's role in these activities, and the observation of students' mathematical thinking processes. The instructional methods employed in this course include lectures, discussions, structured group work, question-and-answer sessions, brainstorming, literature review, and skill development exercises. Furthermore, students will engage in designing mathematical modeling activities and developing classroom applications, with the aim of fostering critical and analytical thinking skills.
Recommended Optional Programme Components	:	To enhance the effectiveness of this course, several key considerations should be taken into account. Firstly, creating an interactive and student-centered learning environment is crucial to encouraging active participation in mathematical modeling activities. Incorporating real-world problems and interdisciplinary connections will help students understand the practical significance of mathematical models. Moreover, integrating technological tools and digital simulations can facilitate the visualization and analysis of complex mathematical models, thereby enhancing students' problem-solving abilities. Establishing feedback mechanisms that include both formative and summative assessment methods will be beneficial in tracking student progress and providing constructive feedback. Furthermore, fostering collaboration through group projects and peer discussions will enable students to exchange diverse perspectives and problem-solving strategies. Lastly, ensuring continuous professional development opportunities for instructors will support the effective implementation and ongoing improvement of modeling-based teaching approaches.
Instructors	:	Prof. Dr. Şenol Kartal
Instructor's Assistants	:	There is no teaching assistant assigned for this course.
Presentation Of Course	:	This course is designed to explore mathematical modeling and problem-solving processes while examining the role and applications of modeling in mathematics education. The course provides an in-depth analysis of the key stages of the modeling cycle—problem identification, manipulation, prediction, and validation—along with a detailed discussion of the fundamental steps and principles of model development. Additionally, the course addresses the implementation of modeling activities in mathematics classrooms, the teacher's role in the process, and the observation of students' mathematical thinking. These topics are covered through a combination of theoretical knowledge and practical applications. Various instructional methods, including lectures, discussions, structured group work, question-and-answer sessions, brainstorming, literature review, and skill development exercises, are employed to create an engaging and interactive learning environment. Furthermore, students will design mathematical modeling activities and explore classroom applications, with the goal of fostering critical and analytical thinking skills.
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Course Outcomes

Upon the completion of this course a student :

1 Can explain the concept of mathematical modeling and modeling processes.

2 It can solve modeling problems.

3 It can develop modeling problems.

4 Evaluate students' solutions to modeling problems.

5 It can benefit from mathematical modeling for different purposes in teaching mathematics.

6 Develops indoor/outdoor modeling applications.

7 Can explain the relationship between mathematics and real life.

Preconditions

Course Code	Course Name	Teorical	Practice	Laboratory	Credits	ECTS

Weekly Contents

	Teorical	Practice	Laboratory	Preparation Info	Teaching Methods	Course Learning Outcomes

	Teorical	Practice	Laboratory	Preparation Info	Teaching Methods	Course Learning Outcomes
1.Week	*Course introduction, syllabus review, model and the use of models in mathematics education			*Book: Read Chapter 1 of "Mathematical Modeling in Mathematics Education" to understand the definitions, fundamental characteristics, and importance of mathematical modeling in education. Comprehend the relationship between modeling and problem-solving and analyze how modeling processes can be integrated into teaching. Review the provided explanations on modeling perspectives and examine examples of how they are applied in education.	*This week, the general framework, objectives, and syllabus of the course will be introduced. The role and importance of modeling in mathematics education will be discussed, and students will be introduced to the fundamental principles of modeling. A general overview of how the modeling process is used in different disciplines will be presented. After providing fundamental information through the lecture method, students' prior knowledge and opinions on modeling will be gathered using the discussion method to determine the focus areas for the following weeks.	Ö.Ç.1
2.Week	*Model and modeling relationship, mathematical modeling (example models)			*Book: Read Sections 1.1 and 1.2 of "Mathematical Modeling in Mathematics Education" to analyze the classification of modeling perspectives and their role in education. Gain insights into different model types (descriptive, explanatory, predictive) and evaluate how these models can be implemented in teaching.	*This week, the fundamental differences between the concepts of models and modeling will be discussed. How the modeling process is used in teaching and learning contexts will be examined, and students will be provided with examples of how modeling can serve as a tool in mathematics education. The lecture method will be used to deliver theoretical knowledge, followed by problem-based learning, where students will be encouraged to develop their own modeling processes.	Ö.Ç.1
3.Week	*Mathematical modeling process and examination of different modeling processes in the literature			*Book: Read Chapter 2 of "Mathematical Modeling in Mathematics Education" to understand the fundamental components of the modeling process. Analyze how the modeling process operates, covering stages such as problem identification, mathematical formulation, solving, interpretation, and evaluation.	*This week, the stages of the mathematical modeling process will be detailed, and different modeling approaches found in the literature will be examined. Examples will be provided to illustrate how the modeling process is used in problem-solving. First, the lecture method will be used to establish the theoretical framework, followed by case study analysis, where applications of the modeling process in different contexts will be evaluated.	Ö.Ç.1
4.Week	*The role and importance of mathematical modeling in mathematics education			*Book: Read Chapter 3 of "Mathematical Modeling in Mathematics Education" to learn about modeling competencies and how they can be developed. Analyze the classification of modeling competencies and their contributions to students' engagement in the modeling process.	*This week, the effectiveness of modeling as a teaching tool in mathematics education will be discussed. The impact of model-based instruction on student achievement will be examined using studies from the literature. The lecture method will be used to present instructional strategies, and cooperative learning activities will be organized to facilitate student discussions and knowledge exchange.	Ö.Ç.1 Ö.Ç.2 Ö.Ç.3
5.Week	*Different modeling perspectives (example activities based on different perspectives)			*Book: Read Chapter 4 of "Mathematical Modeling in Mathematics Education" to examine how modeling activities can be integrated into teaching. Explore strategies for incorporating modeling activities in mathematics lessons and analyze the role of teachers in this process.	*This week, different modeling approaches (descriptive modeling, explanatory modeling, predictive modeling, etc.) will be comparatively examined, and discussions will focus on which types of modeling are more effective in different educational contexts. Comparative learning will be used to analyze different modeling approaches, while project-based learning will encourage students to develop their own modeling processes.	Ö.Ç.3 Ö.Ç.4

	Teorical	Practice	Laboratory	Preparation Info	Teaching Methods	Course Learning Outcomes
6.Week	*Mathematical modeling competencies			*Book: Read Section 4.3.1 of "Mathematical Modeling in Mathematics Education" to analyze solution processes of example modeling problems such as the "Big Foot Problem."	*This week, commonly used modeling techniques in mathematics teaching and their classroom applications will be examined. Students will be introduced to different modeling techniques, and discussions will focus on how these techniques can be integrated into the problem-solving process. The lecture method will be used to explain fundamental concepts, followed by modeling techniques, where practical exercises will be conducted.	
7.Week	*Examination of the relationship between the mathematical modeling process and modeling competencies			*Book: Read Sections 4.4 and 4.5 of "Mathematical Modeling in Mathematics Education" to examine the integration of modeling activities into teaching processes.	*This week, real-world applications of the mathematical modeling process will be analyzed through case studies. Various case studies from different fields will be examined to understand how modeling processes evolve in different contexts. Case study examination will be used for analysis, while applied learning will enable students to develop their own solutions.	Ö.Ç.4 Ö.Ç.5
8.Week	*Midterm exam week			*Midterm exam week	*Midterm exam week	
9.Week	*The use of modeling activities in teaching (example activities)			*Book: Read the introduction of Chapter 5 in "Mathematical Modeling in Mathematics Education" to learn about the classification of modeling problems and the problem-solving process. Examine how real-world problems are structured through mathematical modeling, and analyze different types of problems to understand how models are developed. Follow the step-by-step examples provided in the book to practically assess the modeling process.	*This week, uncertainties in the mathematical modeling process and problem-solving methods will be examined to enhance students' critical thinking skills. Students will be encouraged to approach the modeling process from different perspectives. The lecture method will establish the theoretical framework, while critical thinking-based learning will support students' problem-solving processes. *This week, the problem-based learning method will be used to help students develop their modeling processes. Modeling applications will be carried out using real-world problems, and students will be encouraged to generate their own solutions. The discussion method will explore different approaches, followed by problem-based learning, where students will experience the modeling process through individual and group activities.	Ö.Ç.4 Ö.Ç.5 Ö.Ç.6
10.Week	*The use of modeling activities in teaching (example activities)			*Book: Read Section 5.1 of "Mathematical Modeling in Mathematics Education" to analyze technology-assisted modeling processes. Examine how computer software and digital tools are integrated into the modeling process, and evaluate how these tools can be used in mathematics education. Study the technology-supported modeling examples provided in the book to understand their advantages and limitations.	*This week, applied learning techniques will be used to help students better understand the modeling processes. The real-world applications of various mathematical models will be examined, and students will experience different modeling techniques. Through applied learning, students will engage in hands-on modeling processes, while simulation-based learning will enable them to develop solutions for realistic problems.	Ö.Ç.4 Ö.Ç.5 Ö.Ç.6
11.Week	*Characteristics of modeling activities based on different modeling perspectives			*Book: Read Section 5.2 of "Mathematical Modeling in Mathematics Education" to explore how real-world problems can be solved through mathematical modeling. Analyze how modeling processes are applied in science, engineering, economics, and social sciences. Study the examples provided in the book to understand the step-by-step approach needed to solve real-world problems.	*This week, the role of reflective thinking in modeling processes will be discussed. Students will be encouraged to evaluate and improve their own modeling processes. The lecture method will provide theoretical insights, followed by reflective thinking activities, where students will assess their learning processes and receive feedback.	Ö.Ç.5 Ö.Ç.6 Ö.Ç.7

	Teorical	Practice	Laboratory	Preparation Info	Teaching Methods	Course Learning Outcomes
12.Week	*Implementation process of modeling activities in the classroom environment			*Book: Read Section 5.3 of "Mathematical Modeling in Mathematics Education" to examine the role of teachers in guiding the modeling process. Analyze how teachers can support students in modeling activities and explore instructional strategies for facilitating the modeling process. Study the suggested approaches in the book to understand how student development can be enhanced during modeling activities.	*This week, research-based modeling applications in mathematics teaching will be examined. The relationship between scientific research processes and modeling will be explained, and students will be encouraged to work on research projects based on modeling. Cooperative learning activities will support group collaboration, while research-based learning will help students analyze modeling processes.	Ö.Ç.6 Ö.Ç.7
13.Week	*Design process of example mathematical modeling activities			*Book: Read Section 5.4 of "Mathematical Modeling in Mathematics Education" to understand how the modeling process is evaluated. Study the assessment strategies provided in the book to explore methods for evaluating students' progress in modeling activities. Analyze how cognitive difficulties in the modeling process can be identified and assessed using various evaluation techniques.	*This week, students will develop their modeling processes using the project-based learning approach. They will be expected to create individual or group projects to gain a deeper understanding of the modeling process. Project-based learning will guide students in managing their modeling processes, while interactive learning activities will support their learning experience.	Ö.Ç.4 Ö.Ç.5 Ö.Ç.6
14.Week	*Design process of sample mathematical modeling activities			*Book: Mathematical Modeling in Mathematics Education. Read Section 5.5 to understand how student projects should be integrated into the modeling process. Analyze the provided examples to learn strategies that help students elaborate on their modeling processes in detail. Review the evaluation criteria presented in the book for assessing student projects, and reflect on how the modeling processes can be made more effective.	*This week, the modeling process will be evaluated using student-centered learning approaches. Students will be encouraged to increase their individual awareness and assess their learning outcomes throughout the modeling process. Through student-centered learning activities, learners will be supported in managing their own learning processes, and inquiry-based learning will be employed to enhance their critical thinking skills.	Ö.Ç.5 Ö.Ç.6 Ö.Ç.7 Ö.Ç.5 Ö.Ç.6 Ö.Ç.7 Ö.Ç.5 Ö.Ç.6 Ö.Ç.7 Ö.Ç.5 Ö.Ç.6 Ö.Ç.7
15.Week	*Micro-teaching practices for mathematical modeling			*Book: Read Section 5.6 of "Mathematical Modeling in Mathematics Education" to understand how student projects should be presented and evaluated. Study the recommendations in the book to explore assessment methods for student performance in modeling activities. Analyze how the learning outcomes of student modeling projects can be assessed and how this process can be effectively integrated into teaching.	*This week, the modeling processes covered throughout the semester will be holistically evaluated, and discussions will focus on how students can apply the concepts they have learned. Students will be encouraged to present their individual and group work, and feedback will be provided to assess their success in the modeling processes. The discussion method will be used for students to share their learning experiences, while practical analysis activities will help evaluate the modeling processes.	Ö.Ç.4 Ö.Ç.5 Ö.Ç.6 Ö.Ç.7 Ö.Ç.4 Ö.Ç.5 Ö.Ç.6 Ö.Ç.7

Assesment Methods %

1 Ara Sınav : 40.000
3 Final : 0.000
4 Ödev : 60.000

ECTS Workload

Activities	Count	Time(Hour)	Sum of Workload
Vize	1	1.00	1.00
Derse Katılım	14	2.00	28.00
Ders Öncesi Bireysel Çalışma	14	5.00	70.00
Ara Sınav Hazırlık	7	2.00	14.00
Ödev	7	2.00	14.00
Rapor	1	1.00	1.00
		Total :	128.00
		Sum of Workload / 30 (Hour) :	4

Activities	Count	Time(Hour)	Sum of Workload
			ECTS : 4.00

Program And OutcomeRelation

	P.O. 1	P.O. 2	P.O. 3	P.O. 4	P.O. 5	P.O. 6	P.O. 7	P.O. 8	P.O. 9	P.O. 10	P.O. 11	P.O. 12	P.O. 13	P.O. 14	P.O. 15	P.O. 16	P.O. 17	P.O. 18	P.O. 19	P.O. 20	P.O. 21	P.O. 22	P.O. 23	P.O.
L.O. 1	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L.O. 2	0	0	4	0	0	0	0	0	0	0	0	4	0	0	0	4	0	4	0	0	4	0	0	0
L.O. 3	4	0	0	0	4	0	4	4	0	4	0	4	0	0	0	4	0	4	0	0	4	0	0	0
L.O. 4	4	4	4	0	4	0	0	4	4	0	0	0	4	0	0	4	0	0	0	0	0	0	0	0
L.O. 5	4	4	0	4	4	0	0	4	0	0	0	4	0	0	0	4	0	4	4	0	4	0	0	4
L.O. 6	4	0	4	0	0	4	4	0	0	0	0	5	0	5	0	0	0	4	0	0	4	0	0	4
L.O. 7	4	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	4	5	0	0	0	0	0	4
Avarage	2.86	1.14	2.29	0.57	1.71	1.29	1.71	1.71	0.57	0.57	0	2.43	0.57	0.71	0	2.29	0.57	3.00	0.57	0	2.29	0	0	1.7

BEWARE OF PLAGIARISM! Please pay attention to proper academic citation rules and avoid plagiarism, an unethical and academically fraudulent behavior, when completing reports, assignments, or other academic works, and it is treated with the same disciplinary action as cheating in a classroom setting. It is imperative to refrain from presenting another person s ideas, language, expressions, or any other form of intellectual property as your own. Regardless of quality, your assignments/projects/research should reflect your original work. Perfection is not a requirement, and in case of any uncertainties regarding academic writing guidelines, you may seek clarification from your course instructor.

Engel Durumu/Uyarlama Talebi : Engel durumuna ilişkin herhangi bir uyarlama talebinde bulunmak isteyen öğrenciler, dersin öğretim elemanı ya da Nevsehir Engelli Öğrenci Birimi ile en kısa sürede iletişime geçmelidir.