ATILIM UNIVERSITY
1996
Mechanical Engineering

COURSE SYLLABUS

[ME456] MODELING AND SIMULATION IN MECHANICAL ENGINEERING

Course Information for 2025-26 Fall Semester (Section 1)

Instructor: Assist. Prof. Dr. Murat Büyük
***Office Hours**:* 09:30-11:20 Monday (or by appointment) | ***Room**:* Dept. of ME, 3030
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Course Code: ME456
Course Section: 1
Course Title: Modeling and Simulation in Mechanical Engineering
Course Credit:3
Course ECTS:5.0
Course Catalog Description:
Learning the fundamental concepts of mathematical modeling; developing mathematical models that include basic physical parameters such as temperature, flow, pressure, velocity, stress, and strain, and applying these parameters in various engineering fields; examining numerical solution techniques for ordinary and partial differential equations, and solving engineering problems using numerical methods such as Euler and Runge-Kutta; developing and analyzing models using pre-processors, solution modules, and post-processors; integrating mathematical models into real-world engineering problems.

Prerequisites:
ME316 and ENE301

Schedule:

Course Objectives:
Understand the fundamental goals and principles of mathematical modeling in mechanical engineering; develop and apply mathematical models incorporating basic physical parameters such as temperature, flow, pressure, velocity, stress, and strain; master various numerical methods for solving differential equations, reinforced through practical examples; gain comprehensive knowledge of software tools used in mathematical modeling, theoretical and practical understanding of how pre-processors, solution modules, and post-processors work; learn to integrate mathematical models into real-world engineering problems, enhancing problem-solving skills and practical application.

Outline (might change slightly):

Session	Topic
1	Principles of mathematical modeling, the nature of modeling, and simulation.
2	Physical and mathematical models, state variables, and system parameters.
3	Classification of mathematical models, experimental data, and simulation techniques.
4	Mechanical models and ordinary differential equations (ODEs).
5	Numerical solution methods for ordinary differential equations.
6	Systems of ODEs and numerical solution techniques.
7	General concepts for the numerical solutions of partial differential equations (PDEs).
8	Finite difference method and finite element method.
9	Finite volume method.
10	Numerical solutions of the heat equation.
11	Numerical solutions for structural mechanics problems.
12	Numerical solution techniques for dynamic problems.
13	Software packages used in mathematical modeling: pre-processing, solvers, and post-processing.
14	Modeling strategies
15	Validation & Verification
16	Design Project

COURSE SYLLABUS

Textbook(s):

- Velten, K. Mathematical Modeling and Simulation: Introduction for Scientists and Engineers, Wiley-VCH
- Basmadjian, D. Mathematical Modeling of Physical Systems: An Introduction, Oxford University Press.
- Gadala, M. S. Finite Elements for Engineers with Ansys Applications, Cambridge: Cambridge University Press.
- Madenci, E., Guven, I. The Finite Element Method and Applications in Engineering Using ANSYS, Springer.

Grading Policy:

Assignment-1(Midterm-1)	25 %
Assignment-2 (Midterm-1)	25 %
Presentation	10 %
Final Project (Final)	40 %

Assessment:
(wrt: https://www.atilim.edu.tr/en/ects/page/3498/grading)
Catalog Grading will **strictly** be utilized.

Letter Grade	Coefficient	Score intervals
AA	4,00	90-l00
BA	3,50	85-89
BB	3,00	80-84
CB	2,50	75-79
CC	2,00	70-74
DC	1,50	65-69
DD	1,00	60-64
FD	0,50	50-59
FF	0,00	0-49
NA	0,00	*

Exam Dates:
MIDTERM-1: TBD
MIDTERM-2: TBD
FINAL: [TBD by the Department]
MAKE-UP: [TBD by the Department]

Course Policies:
(wrt: https://www.atilim.edu.tr/en/home/page/113/legislation and
https://www.atilim.edu.tr/files/yonetmelikler/eng/1.4%20-%20At%C4%B1l%C4%B1m%20University%20Regulations%20on%20Associate%20and%20Undergraduate%20Degree%20Education%20and%20Examination.docx

Class Attendance:
Students should attend all classes on a regular basis so that they can benefit from the course at maximum level. The lectures will be given face-to-face. **All students must sign an attendance sheet in class that resembles as a memorandum of understanding for the details in the syllabus.**

Final Exam and Make-up Exam Entrance Conditions:
There will be only one make-up exam after the Final exam for those of you who have special conditions and have been unable to attend any of the examinations with a proof and supporting documents. The make-up examination may not resemble the other examinations as regards its form and content and will take place shortly after the final exam. The grade obtained in the make-up examination will be treated as the grade obtained in the unattended examination only. All announcements and procedures for the make-up examination are revealed right after the final exam (registration, exam date, rules and regulations). When available, please follow the instructions for the registration. A medical report approved by the medical services of the university will be required. Since the students who will have an advantage on taking a make-up exam, by studying longer or learning the types of similar questions etc. one should expect a level of higher difficulty for the make-up examination.

Students with Disabilities:
Students who experience difficulties due to their disabilities and wish to obtain academic adjustments and/or auxiliary aids must contact Office for Students with Disabilities and/or course instructor and the advisor of students with disabilities at academic departments as soon as possible. For detailed information, please visit the website of Disability Support Office: https://www.atilim.edu.tr/en/engelli-ogrenciler-ofisi/page/1413/office-for-students-with-disabilities

Student Development and Counseling Center:
Atılım University Student Development and Counseling Center is established to assist our students in realizing their potential in the fields of psychological, educational and social development and to provide consultancy services on the path to success in their education.
https://www.atilim.edu.tr/tr/od/page/100/ogrenci-gelisim-ve-danisma-merkezi

Conditions and dates can be modified through announcements during the class hours. Follow Moodle Portal.