MAT 451: Mathematical Modeling

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Office Hours: Mondays and Wednesdays 9-10 AM or By Appointment (by email)
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Course Description

Historically, mathematics has played an important role in the study of physics and engineering. This course will provide an introduction to the development and analysis of mathematical models where most examples come from the physical sciences, focusing on models based on differential equations. However, students will have an opportunity to explore mathematical models in any application domain of interest, including but not limited to biology, chemistry, social sciences, and data science. We will also use computational methods to perform numerical simulations for many of the models discussed in class using tools that will be introduced during the course. The course will be organized around basic mathematical content, learning how to use software and tools for model development, analysis and simulation, development of student projects, presentations, and discussions motivated by relevant published articles.

Required Materials

There is no required text. If you are interested in purchasing a book that will cover some of the basic material in the class, you should see:

Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering, Second Edition, Steven H. Strogatz, ISBN 10: 0813349109

Prerequisites

MAT 274 or 275 with C or better; MAT 242, 342 or 343 with C or better

Course Objectives

The main objective of this course is to get you thinking about how to use the math you have learned up to now to model scientific phenomena. The first half of the course will mostly follow a traditional lecture format to get everyone on the same page with mathematical content. The second half of the course will be project-based and more exploratory. Students will have a wide choice of several predesigned projects to choose from. Students are welcome to design their own final project under the guidance of the instructor. Modeling can be quite open ended, and the course will place a heavy emphasis on *interpretation* of the equations and techniques used to build a successful model.

Expected Learning Outcomes

- Students will learn bread and butter mathematical techniques that are often used in mathematical modeling.
- Students will gain an understanding of how different mathematical choices affect the design of a successful model.
- Students will learn how to interpret their results and refine their mathematical models in accordance with the scientific method.

Grading

Scale: A: 90% and above, B: 80-89%, C: 70-79%, D: 60-69%
Breakdown: Homework and classwork, 60%, Final Project, 40%
Assignments will consist of four homework assignments to reinforce main mathematical techniques, 2-3 small modeling projects to reinforce modeling techniques and use of software, and updates throughout the semester about progress on the final project. The final project includes a concise technical report (4-8 pages) and a short presentation at the end of the semester.

Attendance Policy

Please reach out right away in the event of illness or other difficulties that cause problems in completing course assignments or attending class so that we can immediately create a plan of accommodation. I hope you attend class meetings as much as possible. Some assignments will be based on class participation.

Honors Students

Let me know if you would like to sign a contract for a project as part of the Honors curriculum to satisfy the requirements of Footnote 18. This must be set up during the first two weeks of the semester.

Expected Classroom Behavior

- No class content may be recorded.
- Cell phones are not permitted during class time, barring where there are extenuating circumstances.
- Eating small snacks in class is permitted, but please refrain from eating large meals as this may be disruptive.

Accommodation for Religious Practices

The university community should, in all its activities, be sensitive to the religious practices of the various religious faiths represented in its student body and employees. Faculty are asked to recognize the obligations of their students who may be participating in the observance of religious holidays. Students should notify faculty at the beginning of the semester about the need to be absent from class due to religious observances. For more information, visit http://www.asu.edu/aad/manuals/acd/acd304-04.html

Missed Classes Due to University-Sanctioned Activities

Students who participate in university-sanctioned activities that require classes to be missed, shall be given opportunities to make up examinations and other graded in-class work. Normally, the made-up work will be due on the class day immediately after the absence. Absence from class or examinations due to university-sanctioned activities does not relieve students from responsibility for any part of the course work required during the period of the absence. For more information, visit http://www.asu.edu/aad/manuals/acd/acd304-02.html

Academic Integrity and Anti-Plagiarism Policy

Academic honesty is expected of all students in all examinations, papers, and laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see
http://provost.asu.edu/academic-integrity

Plagiarism of any kind will not be tolerated. Students must take the exams independently without assistance from other students. Students may not submit papers written by persons other than themselves. Students must submit original work for this course and may not submit papers previously submitted to (an) other class (es). The ASU student academic integrity policy lists violations in detail. These violations fall into five broad areas that include but are not limited to: (1) Cheating on an academic evaluation or assignment; (2) Plagiarizing; (3) Academic deceit, such as fabricating data or information; (4) Aiding academic integrity policy violations and inappropriately collaborating; (5) Falsifying academic records. See https://provost.asu.edu/academic-integrity

Disruptive, Threatening, or Violent Behavior

In the classroom and out, students are required to conduct themselves in a manner that promotes an environment that is safe and conducive to learning and conducting other university-related business. All incidents and allegations of violent or threatening conduct by an ASU student will be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students. Such incidents will be dealt with in accordance with the policies and procedures described in Section 104-02 of the Student Services Manual, available at http://www.asu.edu/aad/manuals/ssm/ssm104-02.html

Accommodating Students with Disabilities

Students who feel they will need disability accommodations in this class but have not registered with the Student Accessibility and Inclusive Learning Services office should contact SAILS immediately. The SAILS Tempe office is located on the first floor of Wilson Hall, East Lobby. SAILS staff can also be reached at (480) 965-1234 (V) or (480) 965-9000 (TTY). For additional information, visit: www.asu.edu/studentaffairs/ed/drc.

Copyright

Students must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement. For more information, see the Computer, Internet, and Electronic Communications Policy at http://www.asu.edu/aad/manuals/acd/acd125.html

Prohibition Against Discrimination, Harassment, and Retaliation

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish discuss any concerns confidentially and privately.