



Math 609: Mathematical Methods for Systems Biology

Number of Credits: 3 credits

Course URL:

[https://people.math.wisc.edu/~craciun/Math BMC Biochem 609 Spring 2022.html](https://people.math.wisc.edu/~craciun/Math_BMC_Biochem_609_Spring_2022.html)

Course Designation or Attributes: none

Meeting Time and Location: TR 1:00-2:15pm in room B223 Van Vleck Hall.

Instructional Mode: Face to face

Credit hours: This class meets for two 75-minute class periods each week over the semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc) for about 3 hours out of classroom for every class period. The syllabus includes more information about meeting times and expectations for student work.

INSTRUCTOR:

Gheorghe Craciun, PhD

Office hours and location: Tue 2:15-3:15pm and/or by appointment, Van Vleck Hall 405

Email: craciun@wisc.edu

OFFICIAL COURSE DESCRIPTION

Provides a rigorous foundation for mathematical modeling of biological systems. Mathematical techniques include dynamical systems and differential equations. Applications to biological pathways, including understanding of multistability, oscillations, persistence, and global stability within biochemical reaction systems. Examples from biochemistry, cell biology, and population dynamics throughout.

Enroll Info: Knowledge of undergraduate linear algebra, analysis and dynamical systems is strongly recommended.

Prerequisites

MATH 415 and (MATH 320, 340, 341 or 375) or graduate or professional standing or member of the Pre-Masters Mathematics (Visiting International) Program

LEARNING OUTCOMES

At the end of this course students should be able to:

- Use differential equations, dynamical systems, and linear algebra to solve mathematical problems that arise in biochemistry, chemical engineering, cell biology, and population dynamics.
- Use MATLAB or other software for numerical analysis and simulation of mathematical models in systems biology.
- Study equilibrium states and their stability
- Study departures from equilibrium (global dynamics problems, Lyapunov functions, multistability, oscillations, chaotic dynamics)

Textbooks

- Main textbook: *“Foundations of Chemical Reaction Network Theory”*, by Martin Feinberg.
- *“Nonlinear Dynamics And Chaos: With Applications To Physics, Biology, Chemistry, And Engineering”*, by Steven Strogatz.
- *“An introduction to systems biology: design principles of biological circuits”*, by Uri Alon.

GRADING

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|------------------------|-----|
| • Midterm Exam | 30% |
| • Final Exam | 30% |
| • Homework Assignments | 40% |

EXAMS

Midterm exam and Final exam dates TBA.

HOMEWORK & OTHER ASSIGNMENTS

- Homework: There will be weekly or bi-weekly homework assignments. Students are encouraged to discuss the problems with classmates, but the final write-up should be done by each individual student. Some of the homework problems may involve finishing up the problems we work on in class and writing up solutions from class.

RULES, RIGHTS & RESPONSIBILITIES

- See the Guide’s to [Rules, Rights and Responsibilities](#).

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison’s community of scholars in which everyone’s academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication,

plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to <https://conduct.students.wisc.edu/academic-integrity/>.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: “The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.”

<http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php>

DIVERSITY & INCLUSION

Institutional statement on diversity: “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.” <https://diversity.wisc.edu/>