Department of Mathematics & Statistics
Concordia University

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MATH 474
Linear & Nonlinear Dynamics
Fall 2023

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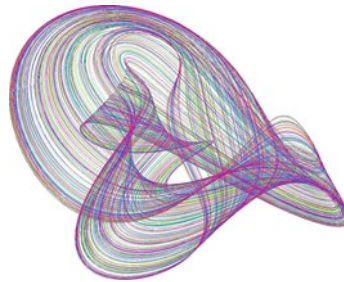
Instructor:	Dr. J. Bramburger, Office: LB 901-21 (SGW), Phone: (514) 848-2424, Ext. 7533
	Email: jason.bramburger@concordia.ca
	Course Website: Moodle
Lectures:	Tuesdays and Thursdays, 10:15-11:30 AM.
Office Hours:	Tuesdays, 13:00-16:00, in LB 795-06.
	Virtual: By appointment only.

Course Topics and Goals:

This course gives an overview of the theory and applications of dynamical systems modelled by differential equations and maps. We will discuss changes of the dynamics when parameters are varied, investigate periodic and homoclinic solutions that arise in applications, and study the impact of additional structures such as time reversibility and conserved quantities on the dynamics. We will also study systems with complicated "chaotic" dynamics that possess attracting sets which do not have integer dimension. Applications to chemical reactions, climate, epidemiology, and phase transitions will be discussed.

By the end of the course, you will

- have intuition into the dynamics of planar differential equations;
- be able to extract and sketch dynamical features of differential equations in two and three dimensions;
- be able to predict qualitative changes in the dynamics of mathematical models triggered by parameter changes;
- be able to interpret solutions to mathematical models in the original context.

Prerequisites: MATH 265, MATH 365, or equivalent.

Textbook: There is no required textbook as lectures will provide all relevant material and separate assignments with problems will be provided on CANVAS. However, we will closely follow the textbook:

- Nonlinear Dynamics and Chaos, Steven Strogatz, Westview Press.

Another resource that will complement the course material is:

- Differential Dynamical Systems, James Meiss, Society for Industrial and Applied Mathematics (SIAM).

Instruction: Lectures will be held in-person at the times stated above. I will also post lightboard video lectures to my YouTube channel that can be used to prepare for or review class material. If you are feeling ill in any way you are encouraged to stay home and use the lecture videos to keep up-to-date with the course. You are strongly encouraged to attend class as the videos are only meant to be supplementary material and therefore may not contain everything that is covered in the lecture.

Assessments: Your grade in this course will be assigned according to the following system:

30%   Final Exam
30%   Midterm
40%   Assignments

If the grading scheme for this course includes graded assignments, a reasonable and representative subset of each assignment may be graded. Students will not be told in advance which subset of the assigned problems will be marked and should therefore attempt all assigned problems.

Assignments: There will be weekly assignments. Assignments are very important; they indicate the level of difficulty of the problems that the students are expected to understand and solve. Therefore, every effort should be made to do and understand them *independently*. The assignments will be corrected and a representative sample graded (some problems may be not graded), with solution sets posted after the due date. Late assignments will **not** be accepted without a legitimate excuse and prior approval.

Tests: This course will have a midterm test and final examination. The midterm will cover the first half of the course, while the final will cover the second half.

Calculators: Electronic communication devices (including cell phones) are not permitted in examination rooms. Only calculators approved by the Department (with a sticker attached as proof of approval) are permitted for the class test and final examination.   For   a   list   of   Approved   calculators   see http://www.concordia.ca/artsci/math-stats/services.html #calculators.

Accommodations for Students with Disabilities

If you need accommodations for classes, assignments, or exams, please contact me and the Access Center for Students with Disabilities. Website: https://www.concordia.ca/students/accessibility.html

Counselling and Psychological Services

Counselling and Psychological Services offers short-term counselling to register Concordia students who are in Quebec. Appointments can be either virtual and in-person. Website: https://www.concordia.ca/health/mental-health.html

Diversity and Inclusion Statement

Concordia University is an intentionally inclusive community that promotes and maintain an equitable and just work and learning environment. We welcome and value individuals and their differences including race, economic status, gender expression and identity, sex, sexual orientation, ethnicity, national origin, first language, religion, age and disability. I invite and respect any concerns about inequitable access or treatment in this course.

I strive to create a learning environment for you that supports a diversity of thoughts, perspectives, and experiences, and honours your identities. To help accomplish this:
- If you have a name and/or set of pronouns that differ from those that appear in your official Concordia records, you are encouraged to let me know.
- If you feel your performance in the course is being impacted by your experiences outside of class, please come talk to me.
- I am still in the process of learning about inclusion, diverse perspectives and identities. If something was said in class (by anyone, including me) that made you feel uncomfortable, please talk to me about it.
- As a participant in course discussion and problem-based sessions, you should strive to honour the diversity of your classmates.

Additional Course Policies
- No cell phones or computers allowed during class time.
- All announcements will be posted on Moodle. Be sure your Moodle notifications are turned on, and you check them regularly.
- I am here to facilitate your learning; let me know if you have questions! I can always be reached by e-mail, and can schedule additional office hours should you need them.

Academic Integrity and the Academic Code of Conduct

This course is governed by Concordia University's policies on Academic Integrity and the Academic Code of Conduct as set forth in the Undergraduate Calendar and the Graduate Calendar. Students are expected to familiarize themselves with these policies and conduct themselves accordingly. "Concordia University has several resources available to students to better understand and uphold academic integrity. Concordia's website on academic integrity can be found at the following address, which also includes links to each Faculty and the School of Graduate Studies: https://www.concordia.ca/conduct/academic-integrity.html" *[Undergraduate Calendar, Sec 17.10.2]*

Behaviour

All individuals participating in courses are expected to be professional and constructive throughout the course, including in their communications.

Concordia students are subject to the Code of Rights and Responsibilities which applies both when students are physically and virtually engaged in any University activity, including classes, seminars, meetings, etc. Students engaged in University activities must respect this Code when engaging with any members of the Concordia community, including faculty, staff, and students, whether such interactions are verbal or in writing, face to face or online/virtual. Failing to comply with the Code may result in charges and sanctions, as outlined in the Code.

Intellectual Property

Content belonging to instructors shared in online courses, including, but not limited to, online lectures, course notes, and video recordings of classes remain the intellectual property of the faculty member. It may not be distributed, published or broadcast, in whole or in part, without the express permission of the faculty member. Students are also forbidden to use their own means of recording any elements of an online class or lecture without express permission of the instructor. Any unauthorized sharing of course content may constitute a breach of the Academic Code of Conduct and/or the Code of Rights and Responsibilities. As specified in the Policy on Intellectual Property, the University does not claim any ownership of or interest in any student IP. All university members retain copyright over their work.

Extraordinary circumstances

In the event of extraordinary circumstances and pursuant to the Academic Regulations the University may modify the delivery, content, structure, forum, location and/or evaluation scheme. In the event of such extraordinary circumstances, students will be informed of the change.