

THE UNIVERSITY OF WESTERN ONTARIO
London Ontario

Department of Mathematics

**AM 9524A Nonlinear Dynamics:
Bifurcation Theory and Its Application**

(Fall 2021-2022)

1. Time & Place: Monday 2:30-4:30; Wednesday 2:30-3:30, Room MC 204.

First class: September 8

October 11: Thanksgiving holiday (Monday)

November 1-7: Fall reading week (Monday-Sunday)

Last day of classes: December 8

2. Instructor: Pei Yu

Office: MC 283, Ext: 88783, E-mail: pyu@uwo.ca

3. Course Description

(i) **Outline:** This course introduces bifurcation theory and methodologies, and applications to biological and physical systems. Recently developments in this area will also be discussed. Topics mainly focus on Maps and Ordinary Differential Equations, and Delay Differential Equations and Partial Differential Equations will also be discussed. Hopf bifurcation, Bogdanov-Takens bifurcation and homoclinic/heteroclinic bifurcations, which are mostly applied in applications, will be particularly considered. Manifold theory, normal form theory and perturbation theory will be introduced, with examples chosen from real problems and solved using both symbolic and numerical computations.

(ii) **Learning outcomes**

- You will learn to analyze bifurcation phenomenon in differential systems.
- You will learn to apply bifurcation theory to solve real-world problems.
- You will learn to use Matlab and Maple to symbolically or numerically solve bifurcation problems.

(iii) **Covered topics**

- Stability of equilibria
- Periodic attractors
- Bifurcation theory
- Perturbation theory
- Chaos

- Computation methods
- Traveling wave solutions
- Applications

(iv) **Delivery of Lectures:** **In-person** Class room teaching. In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online as determined by the course instructor.

4. Course Materials

There is no textbook for this course. Lecture notes (in .pdf format) will be available online. A list of the pertinent reference literature will be provided.

5. Course Evaluation

The over course grade includes

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| (a) Assignments (5, once every two weeks): | 35% |
| (b) Class attending: | 5% |
| (c) Project (report): | 25% |
| (d) Final examination: | 35% |

6. Accessibility Statement: Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x82147 for any specific questions regarding an accommodation. The policy can be found in

www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

7. Accommodation for Illness: If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a self-reporting of absence or via the Deans Office/Academic Counselling unit of your Home Faculty. The Academic Counselling Office of the Faculty of Science is located in NCB 280, and can be contacted at scibmsac@uwo.ca. For further information, please consult the university's policy on academic consideration for student absences. The poly can be found in

www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

8. Academic Policies: The website for Registrarial Services is

www.registrar.uwo.ca.

In accordance with policy, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the

responsibility of the account holder to ensure that email received from the University at his/her official university address is attended to in a timely manner.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

All assignments, project reports and programming codes may be checked for textual similarity for detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service for papers is subject to the licensing agreement currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

9. Support Services:

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Student Accessibility Services (SAS) at 661-2147 if you have any questions regarding accommodations.

The policy on Accommodation for Students with Disabilities can be found here:

www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic

The policy on Accommodation for Religious Holidays can be found here:

www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Learning-skills counsellors at the Student Development Centre (<http://www.sdc.uwo.ca>) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to Mental Health@Western (www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help. Additional student-run support services are offered by the USC, <http://westernusc.ca/services>.