

# The University of Western Ontario

## Course Outline – AM3813B (FW 2021-2022)

### 1. Course Information

**Course Name:** Applied Mathematics 3813B:

Nonlinear Ordinary Differential Equations and Chaos

**Time and Location:** Lecture – Section 001, Zoom (Online, Synchronous). The course is planned for delivering lectures **in-person**. Due to Ontario lockdown for Covid-19, the lecture delivering must be **online** for the period of Jan. 10 – 31, 2022. Whether it will continue online or change to in-person after Jan. 31, 2022 depends upon the situation. Note that Quiz #2, Midterm Test and Final Examination are now temporarily scheduled in-person, which may be changed to online if the online teaching continues till the test/examination date.

Monday, Wednesday, Friday: 10:30 - 11:30 am, Room UCC-61

**Prerequisites:** AM2402A, or former Differential Equations 2402A; Cal2303A/B or Cal2503A/B and Math 1600A/B or the former Linear Algebra 1600A/B. Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

### 2. Instructor

**Instructor:** Dr. Pei Yu, Professor, Department of Applied Mathematics

Office: MC 283

Email: [pyu@uwo.ca](mailto:pyu@uwo.ca)

Office hours: Monday & Wednesday, 1:30 – 2:30 pm (Zoom)

TA (TBA)

### 3. Course Syllabus

**Course Description:** This course is primarily an introductory course in Nonlinear Ordinary Differential Equations (NLODE), covering classical and modern nonlinear dynamical systems theory and methodology in both difference and differential equations. The materials involve geometric qualitative approach and algebraic quantitative computation. The topics include

“solvable” nonlinear ODEs, perturbation methods, stability and bifurcation, attractors and repellers, chaos and fractals. Maple/Matlab will be used for solving nonlinear ODEs and simulation.

**Learning Outcomes:** By the end of this course you will be able

- to analytically solve basic nonlinear ODEs;
- to apply perturbation methods to find approximate solutions of nonlinear ODEs;
- to use Maple/Matlab to simulate nonlinear ODEs;
- to use the methods learned from this course to study chaotic systems.

**Lectures** (3 lectures each week) will be delivered online (Synchronous) using Zoom, with Lecture notes to be posted on the OWL, and Zoom for office hours. Break-down practical problems and solutions are posted on the OWL for each week.

Classes begin: January 10, 2022

Reading Week: February 19-27, 2022

Classes end: April 08, 2022

## 4. Course Materials

**Course Notes:** Pei Yu and Chris Essex, “Nonlinear Differential Equations and Chaos”, Department of Applied Mathematics, Western University, available from the OWL.

**Notes:**

- The main material of this course is the Lecture notes, and other textbooks provided in a list can be used as reading materials.
- Additional materials including the use of Matlab and Maple to solve Differential Equations will be also posted on the OWL.
- You should check OWL (<http://owl.uwo.ca>) on a regular basis for news and updates.
- If you need assistance, you can contact the Western Technology Services Helpdesk. They can be reached by phone at 519-661-3800 or ext. 83800.

**Technical Requirements:** For lecture classes, you need stable internet connection, computer with working microphone and/or webcam, and the device/software to play screen capture videos.

## 5. Methods of Evaluation

**Quizzes** (2) will be run in the lecture hour. At least one quiz requires you to solve nonlinear

ODEs using computer software (Matlab and Maple).

Quiz 1: January 31, 2022 (online)	10%
Quiz 2: February 28, 2022 (In-person)	10%
Midterm Test: Tuesday, March 9, 7:00-9:30 pm (In-person)	32%
Final Examination: to be scheduled by the Registrar's office (In-person)	43%
Participation (class attendance):	5%

- All materials covered in lectures and assigned problems can be considered testable in the quizzes, midterm and final examination. The problem sets are designed to enhance understanding of the lectures and to develop problem solving skills, which will not be collected and marked.

**Completion of this course** will require you to have a reliable internet connection and a device that meets the system and technical requirements for both Zoom and Proctortrack. Information about the system and technical requirements are available at the following links:

<https://www.proctortrack.com/tech-requirements/>

<https://support.zoom.us/hc/en-us>

**Proctortrack** will require you to provide personal information (including some biometric data). The session will be recorded. By taking this course, you are consenting to the use of this software. More information about remote proctoring is available in the Online Proctoring Guidelines at the following link:

<https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf>

**Academic Accommodation:** Requests for academic accommodation for any evaluation that contribute 30% or more to the total course grade must be made through the Office of the Dean for the student's home faculty. Typically, accommodation requests are not handled directly by the Dean, but are instead handled by the Academic Counsellors housed in the Dean's Office. The Academic Counsellors for students in the Faculty of Science can be found in NCB 280 (Tel. 519 661 3040, Email [scibmasac@uwo.ca](mailto:scibmasac@uwo.ca)).

**No Make-up** for missed quizzes will be arranged. If for a reason to receive an accommodation from the Dean's office, the instructor will give a mark for your missed quiz based on the class average of that quiz you missed.

## 6. Additional Statements

***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 [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_disabilities.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf)

***Accommodation for Illness:*** A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Students Health Services. A link to the Student Medical Certificate is here:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/medicalform.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf)

and the poly can be found in

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_illness.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf)

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to your faculty's Dean's Office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from your faculty's Dean's Office immediately. For further information please see: [http://www.uwo.ca/sci/academic\\_counselling](http://www.uwo.ca/sci/academic_counselling).

A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Students Health Services. The form can be found here: <https://studentservices.uwo.ca/secure>.

***Accommodation for Religious Holidays:*** When scheduling unavoidably conflicts with religious holidays which a) require an absence from the University or b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. The poly can be found in

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_religious.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf)

Statement on services for students in emotional/mental health distress: Students who are in emotional/mental distress should refer to Mental Health@Western <http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help.

***Statement on Remote Learning and Recording:*** Remote learning recordings will capture students' personal information through direct (video, audio, chat logs) and indirect (online identifier, such as name, student number or telephone number) methods. If recording is necessary, then prior to recording, instructors should confirm that recording is necessary and

determine that the purpose and function for the remote learning activity cannot be met in the absence of recording (i.e. the objectives of the activity cannot be met solely in real-time). Provide all participants with a Notice of Recording at the earliest possible opportunity and prior to the start of the recorded session. Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

***Statement on Use of Electronic Devices:*** Calculators, computers, cellphones or any electronic devices which can be used for communication, are not allowed to be used in the quizzes, midterm test and final exam., except for the quiz which asks to use the lab compute.

***Statement concerning online etiquette:*** To ensure the best experience for both you and your classmates, please honour the following rules of etiquette:

- use your computer and/or laptop if possible (as opposed to a cell phone or tablet)
- ensure that you are in a private location to protect the confidentiality of discussions in the event that a class discussion deals with sensitive or personal material
- to minimize background noise, mute your microphone for the entire class until you are invited to speak, unless directed otherwise
- In order to give us optimum bandwidth and web quality, turn off your video camera for the entire class unless you are invited to speak
- please be prepared to turn your video camera off at the instructor's request if the internet connection becomes unstable
- unless invited by your instructor, do not share your screen in the meeting
- If you wish to speak, use the "raise hand" function and wait for the instructor to acknowledge you before beginning your comment or question.
- Please remember to unmute your microphone and turn on your video camera before speaking.
- Self-identify when speaking.
- Please remember to mute your mic and turn off your video camera after speaking (unless directed otherwise).
- Keep in mind the different cultural and linguistic backgrounds of the students in the course.
- Be courteous toward the instructor, your colleagues, and authors whose work you are discussing.
- Be respectful of the diversity of viewpoints that you will encounter in the class and in your readings. The exchange of diverse ideas and opinions is part of the scholarly environment. "Flaming" is never appropriate.
- Be professional and scholarly in all online postings. Use proper grammar and spelling. Cite the ideas of others appropriately.

***Use of cheating-analysis software:*** Quizzes using lab computers may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating. **Scholastic offences** are taken seriously and you are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf).

***Information regarding registration*** can be found in <http://www.registrar.uwo.ca>