

AM9504A (Fall 2024) Course Outline

1. Course Information

AM9512A --- Introduction to Delay Differential Equations (Fall 2024).

Lecture time and location will be announced to enrolled students later.

Prerequisites: Fundamental theories of ordinary differential equations, partial differential equations, real analysis, complex analysis. Ideally also: functional analysis.

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Counselling) 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 Information

Instructors	Email	Office	Phone	Office Hours
Dr Xingfu Zou	xzou@uwo.ca	MC284	88781	TBA

Students must use their Western (@uwo.ca) email addresses when contacting the instructor. Office hours are held in-person in MC284; under special circumstances Zoom or Teams are possible alternative format.

3. Course Syllabus, Schedule, Delivery Mode

This is a special topics course, aiming to introduce to graduate students some fundamental theory and tools of differential equations (DDEs), also called functional differential equations (FDEs), so that when they encounter a problem involving time delay, they can employ the theories and tools learnt in this course to tackle it. Topics include: Basic concepts of FDEs; existence and uniqueness of initial value problems, stability theory of DDEs, Lyapunov direct method, linear stability via characteristic equations, locating roots of some transcendental equations, Hopf bifurcation in DDEs, monotone systems of DDEs, linear train technique, semi-group generated by DDEs, and constant variation method.

Course outcomes: Students are expected to be able to (i) understand all basic notions of DDEs, (ii) confirm/show the existence and uniqueness of a local solution and its extension; (iii) analyze the stability of an equilibrium and possible bifurcation from it; (iv) identify whether a DDE system is monotone or not, and make proper use of properties of monotone DDEs gain insights into the dynamics of some DDE systems; (v) know what DDEs can be transformed to an ODE system by linear train

technique and how to transform, and (vi) formulate a DDE system from a practical problem involving delay phenomenon.

Delivery mode: mainly lecturing in-person.

Classes begin on Friday September 6 and end on December 6, 2024.

Fall Reading Week: October 12 - 20, 2024

4. Course Materials

All course material will be posted to OWL: <https://westernu.brightspace.com/>

Including lecture notes and some related papers for reading. Although no particular textbook is specified, the following books may be of some use/help and thus, can serve as good references for this course:

- Jack Hale and Sjoerd Verduyn Lunel, Introduction to Functional-Differential Equations, Applied Mathematical Sciences, Vol. 99, Springer-Verlag, 1994.
- Yang Kuang, Delay Differential Equations with Applications in Population Dynamics, Academic Press, 1993.
- Odo Diekmann, Stephan van Gils, Sjoerd Verduyn Lunel, Hans-Otto Walther, Delay Equations: Functional, Complex, and Nonlinear Analysis, Applied Mathematical Sciences, Vol. 110, Springer-Verlag, 1995.
- H.L. Smith, Monotone dynamical systems. An introduction to the theory of competitive and cooperative systems, vol 41. AMS, Providence, 1995.
- Driver, R. D., Ordinary and delay differential equations. Applied Mathematical Sciences, Vol. 20., Springer-Verlag, 1977.
- Thomas Erneux, Applied Delay Differential Equations, Springer Science+Business Media, New York, 2009.

Students are responsible for checking the course OWL site (<https://westernu.brightspace.com/>) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800

5. Methods of Evaluation

- Assignment 30 %
- Midterm Test 30 %
- Course Project 40 % = 30% write-up + 10% oral presentation

For assignments, three assignments are tentatively planned. Problems will be assigned on OWL, and completed assignments will be collected and marked. Due times will be announced when posting, and will be strictly followed. If you miss the deadline of an assignment due to an unexpected incidence that can be convincingly justified, I may consider either extending the deadline to a later time no more than 24 hours later, or allocating the weight of that assignment to the rest if it is too late from the deadline.

The Midterm will be on Monday October 28, 7:00-9:00pm. It will be in-person and close-book. No notes and electronic devices, including calculators and cell phones, are allowed. If you miss the midterm, you must provide valid medical or supporting documentation to the me; and if approved, you can be accommodated to write a make-up to be held no more than 48 hours later.

The write-up of the project should be in the form of a research paper, meaning that in addition to the main results part, it should also have a title, an abstract, an introduction, and necessary references. It must be typeset by latex. The write-up will be due on Friday December 6. A later submission will receive penalty calculated by 10% off the total for the project per day within two days (48 hours). The oral presentations will be scheduled to be on Tuesday December 10. Each student will be given 20 minutes to present their project work.

With respect to the three aspects of the evaluation, students are warned of the issue of **scholastic offence** and are accordingly required to read the policies stated in **Part 6**.

[The remaining parts below are adopted from the Faculty of Science course outline template]

General information about missed coursework

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](#).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:

https://registrar.uwo.ca/academics/academic_considerations/

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

6. Additional Statements

Religious Accommodation

When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays:

<https://www.edi.uwo.ca>.

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf.

Academic Policies

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

In accordance with policy,

https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf,

the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

No electronic device is permitted in the midterm exam.

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:

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

Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic-related matters: <https://www.uwo.ca/sci/counselling/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced

sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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 Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.