

**ORDINARY DIFFERENTIAL EQUATIONS AND
NUMERICAL METHODS**

MAT 2384 B – FALL 2022

Instructor:	Diane Guignard (STEM 651, dguignar@uottawa.ca)
Personal webpage:	https://mysite.science.uottawa.ca/dguignar/
Course webpage:	on Brightspace
Classes (ODE):	Tu 08:30am-09:50am in 55 Laurier (DMS) 1140 Fr 10:00am-11:20am in 161 Louis Pasteur (CBY) B205
Classes (Num. Methods):	Fr 11:30am-12:20pm in 161 Louis Pasteur (CBY) B205
Office hours:	Tu 10:30am-12:00pm in STEM 651 or by appointment (on zoom or in person)

Course-related material, such as homework assignments or topics cover per course, will be posted on Brightspace. Important information might also be sent by emails.

Textbook:

Ordinary Differential Equations, Laplace Transforms, and Numerical Methods for Engineers (version 2012.04.23). Notes for the course MAT 2384 by S.J. Desjardins and R. Vaillancourt.

Reference:

Advanced Engineering Mathematics (9th ed) by E. Kreyszig, Wiley, 2006.

Catalog Description:

General concepts. First order equations. Linear differential equations of higher order. Differential operators. Laplace transforms. Systems of differential equations. Series solutions about ordinary points. Numerical methods including error analysis; numerical differentiation, integration and solutions of differential equations.

Prerequisites:

MAT 1341, (MAT 1322 or MAT 1325 or MAT 1332).

Course Outline (tentative):

Course content for the ODE part:

Chapter 1: First-order ODEs

- (1) Introduction, terminology, and basic examples – Theorem of existence and uniqueness
- (2) Separable ODEs and ODEs with homogeneous coefficients
- (3) Exact ODEs and integrating factors
- (4) Linear first-order ODEs, Bernoulli equations

Chapter 2: Homogeneous linear ODEs

- (1) Generalities
- (2) Second-order linear ODEs with constant coefficients
- (3) Second-order Euler–Cauchy equations
- (4) Higher-order linear ODEs with constant coefficients
- (5) Higher-order Euler–Cauchy equations

Chapter 3: Non-homogeneous linear ODEs

- (1) Generalities
- (2) The method of undetermined coefficients
- (3) The method of variation of parameters

Chapter 4: Systems of first-order ODEs

- (1) Generalities
- (2) Homogeneous systems of first-order ODEs with constant coefficients
- (3) Non-homogeneous systems of first-order ODEs with constant coefficients

Chapter 5: Laplace transform

- (1) Definitions, terminology, and first properties of the Laplace transform
- (2) The Laplace transform of basic functions
- (3) The Heaviside function, the Dirac-delta function, and their Laplace transform
- (4) The two shifting theorems
- (5) Solving IVPs using the Laplace transform
- (6) More properties of the Laplace transform

Chapter 6: Power series solutions

- (1) Review on power series (Taylor series, Maclaurin series, and radius of convergence)
- (2) Solution of IVPs with power series

Course content for the numerical methods part:

Chapter 1: Iterative methods for solving equations of the form $f(x) = 0$

- (1) Introduction, the bisection method
- (2) The fixed-point iteration method
- (3) Newton's method, the secant method

Chapter 2: Interpolation

- (1) Lagrange interpolation
- (2) Newton's divided difference interpolation
- (3) Hermite interpolation, cubic splines

Chapter 3: Numerical integration

- (1) The midpoint rule
- (2) The trapezoidal rule
- (3) Simpson's rule
- (4) Gaussian quadrature

Chapter 4: Numerical methods for solving first-order IVPs

- (1) Euler's method
- (2) The improved Euler method (Heun's method)
- (3) The explicit Runge-Kutta method of order 4

Exams:

There will be two midterm exams and one final *comprehensive* exam. The midterms will take place Friday, October 14 and Friday, November 18 during the usual class time. The final exam will be held during the exam period (precise date to be determined). A detailed description of the material covered by each exam will be provided on Brightspace in due time.

Grading Policy:

The final grade will be based on the two midterm exams and the *comprehensive* final exam. It will be computed according to the following distribution:

- **Midterm I:** 25% of your grade;
- **Midterm II:** 25% of your grade;
- **Final exam:** 50% of your grade.

If you miss a midterm for a **valid reason**, then the weight of that midterm will be transferred to the final exam.

If your score at the final exam is less than 40%, then your final letter grade will be F. Otherwise, your final letter grade will be computed according to the standard university scale:

A+ (90%-100%); A (85%-89%); A- (80%-84%); B+ (75%-79%); B (70%-74%); C+ (65%-69%); C (60%-64%); D+ (55%-59%); D (50%-54%); E (40%-49%); F (0%-39%).

Important Dates:

Below is a summary of the important dates for the Fall 2022 term. You will find more information at the website

<https://www2.uottawa.ca/current-students/important-academic-dates-deadlines>

September 7	First day of the term
September 9	First day of this class
October 10	Thanksgiving (no classes)
October 14	Midterm I (10:00am-11:20am in CBY B205)
October 23-29	Reading week (no classes)
November 18	Midterm II (10:00am-11:20am in CBY B205)
December 6	Last day of this class
December 7	Last day of the term (redefined day, Monday course schedule)
December 9-22	Exam period (date to be determined)

Attendance Policy:

Attendance is **STRONGLY** recommended, but attendance will not be taken.

Materials Copyright:

All materials generated for this class are protected by Copyright laws. Distributing copies or sale of any of these materials is strictly prohibited.

Academic Fraud:

Academic fraud is an act by a student that may result in a false evaluation. It is not tolerated by the University. Examples of academic fraud are: plagiarism, cheating of any kind or submit a work for which you are not the author, in whole or part. Any person found guilty of academic fraud will be subject to severe sanctions. Please consult the webpage <https://www.uottawa.ca/vice-president-academic/academic-integrity/resources-students> which contains regulations and tool to help you avoid plagiarism.

Bilingualism:

Except in programs and courses for which language is a requirement, all students have the right to produce their written work and to answer examination questions in the official language of their choice, regardless of the course's language of instruction.

Academic GPS:

The Academic GPS hub is a one-stop shop for academic support. Whether you're an experienced student or just starting out, you'll find some great resources to help you succeed.

With the Academic GPS, you can:

- chat with a mentor seven days a week;
- register for study groups;
- take part in study methods workshops (note taking, time management, exam preparation, stress management, etc.);
- book an appointment with a mentor.

For more information: [uOttawa.saea-tlss.ca/en/academic-gps](https://uottawa.saea-tlss.ca/en/academic-gps).

Health and Wellness:

Your wellness is an integral part of your success. If you don't feel well, it can be hard to focus on your studies. Dedicated professionals and fellow students who care about you are always ready to provide advice and support. Depending on your needs, many activities and services exist to accompany you during your academic journey.

Services include:

- opportunities to connect;
- counselling sessions;
- peer support;
- physical activity;
- wellness activities and workshops;
- spiritual guidance.

If you want to connect with a counsellor, you can book an appointment online or go to their walk-in clinic at 100 Marie-Curie, fourth floor. You can also drop-in to our wellness space, chat online with a peer helper, or access 24/7 professional help through the website.

For more information and to access these services, go to uOttawa.ca/wellness.

Academic Accommodations:

We try to make sure all students with disabilities have equal access to learning and research environments, the physical campus and University-related programs and activities. The Academic Accommodations service works with other campus services to create an accessible campus learning environment, where students with disabilities have an equal opportunity to flourish. We offer a wide range of services and resources, provided with expertise, professionalism and confidentiality.

Services include:

- help for students with disabilities in making the transition;
- permanent and temporary accommodation measures;
- learning strategy development;
- adaptive exams;
- transcriptions of learning material;
- interpretation (ASL and LSQ);
- assistive technologies.

If you think that you might need any of our services or supports, email the Academic Accommodations service (adapt@uOttawa.ca).