

MAT244: Course description

Topics: First order ordinary differential equations: Direction fields, integrating factors, separable equations, homogeneous equations, exact equations, autonomous equations, modeling. Existence and uniqueness theorem. Second order equations: Constant coefficient equations, reduction of order, Wronskian, method of undetermined coefficients, variation of parameters. Numerical methods. First order linear systems, fundamental matrices. Non-linear equations, phase plane, stability. Applications in life and physical sciences and economics.

Prerequisite: (MAT135H1, MAT136H1)/MAT137Y1/MAT157Y1, MAT223H1/MAT240H1

Corequisite: MAT235Y1/MAT237Y1/MAT257Y1

Exclusion: MAT267H1, MAT212H5, MAT258Y5

General information

Lectures section LEC0101: W13 and F12 at BA1660 (Bahen)

- Instructor Tomas Kojar
- email: tkojar@math.toronto.edu
- office hours: F4-6 at Math aid center in PG

Tutorials

- TUT0101: F23 at BA1220
 - TA Mario Palasciano
 - email: mario.palasciano@mail.utoronto.ca
 - office hours: F11-12 at Math aid center in PG
- TUT0201: F34 at BA1220
 - TA Justin Martel
 - email: jmart@math.toronto.edu
- TUT5101: W56 at BA1240
 - TA Etienne Bilocq
 - email: etienne.bilocq@mail.utoronto.ca
 - office hours: W3-4 at Math aid center in PG
- General Math-Aid hours
 - TA Anne Dranovski
 - information on schedule: <http://www.math.toronto.edu/~alfonso/MAC/MAC.html>
 - Location PG101

Email policy:

- Please send email for administrative/marketing purposes only. For math questions, ask your instructor or TAs in person during class/tutorial or office hours.
- You must use your **** @ mail.utoronto.ca email account when sending us emails. Otherwise, they may be filtered as spam and deleted automatically.

Course textbook and resources

Link to main textbook: [William E. Boyce, Richard C. DiPrima, Douglas B. Meade. Elementary Differential Equations and Boundary Value Problems, Enhanced eText, 11th Edition](#)

In Canada it is available as electronic resource only; printed editions are not available (unless by premium price). Meanwhile 10th Edition is out of print.

You can obtain the e-textbook either from the Willey website or the UofT bookstore.

Applied ODEs textbooks: We will draw and post applied problems from the following textbooks (we will post what we need, so you don't need to get them):

"Fundamentals of differential equations" Nagle, R. Kent, Edward B. Saff, and Arthur David Snider.. Pearson Education, 2014.

"Differential equations and boundary value problems." Edwards, C. Henry, David E. Penney, and David T. Calvis. 2004.

"Further Mathematics for Economic Analysis" K Sydsæter, P Hammond, A Seierstad 2008.

Numerical and Online resources

- [Matlab](#) has packages for many types of ODEs. There is a student version that you can buy (50\$-100\$).
- Famously useful online notes from [Paul Dawkins](#)
- Other online notes by [D. Panchenko](#) and [Gabriel Nagy](#).
- [Wolfram alpha](#) can solve you most ODEs with detailed pictures.
- Applets: [Slope and Direction Fields](#) and [Phase Lines](#).
- Access to all [previous sites](#)

Marking scheme

There will be biweekly quizzes (5), two midterms, one assignment (Asg) and a final exam. The term mark (TM) will be computed as follows:

$$TM = 0.37 \cdot M1 + 0.37 \cdot M2 + 0.2 \cdot Q + 0.06 \cdot Asg,$$

where $M1, M2$ are your midterm marks, and Q is the total of your quiz marks of the best 4 out of 5. Your final course mark will be the weighted average of your Term Mark (TM) and your Final Exam Mark (FEM):

$$\text{Course Mark} = 60\% \cdot \max\{FEM, TM\} + 40\% \cdot \min\{FEM, TM\}.$$

Another option for the Term mark is:

$$TM = 0.37 \cdot M1 + 0.3 \cdot M2 + 0.2 \cdot Q + 0.13 \cdot Asg.$$

But you have to inform the instructor.

Quizzes Quizzes will take place at the last 10-20 minutes in your tutorial section. The problem/-s will be drawn from the weekly exercises. It will be an application of one of the techniques learned from class.

Midterms Each midterm will include material up to the previous week of classes but not from the week leading up to the test. They will be during class time. The questions will not be drawn from the weekly exercises, but they will be modifications and combinations of them.

Assignment The assignment will be a month long and posted after the second midterm and it will focus on the Competing species topic.

Final exam It will equally cover the entire class material.

Policy for the term tests, quizzes and final exam

No tools or unauthorized aids are allowed. (This includes cell phones, calculators, and other electronic gadgets.) Any academic offense will be reported to the undergraduate math chair. There will be no makeup quizzes or tests.

Missing Term Work

- If you miss the term test or a quiz for a legitimate reason (e.g. illness, conflict with another course), you must contact your instructor immediately to obtain special permission and provide proper documentations. There will be no make-up term test or make-up quizzes so your grade will be adjusted by increasing the final exam component of your work.
- If you skip the test or quiz without prior approval, you will receive a zero for the test or quiz (unless the absence is due to illness, properly documented). If you cannot show up for the test or quiz because of illness, you should submit your medical documentation to your instructor no later than one week after the day of the test.

Academic integrity

Academic integrity is fundamental to learning and scholarship at the University of Toronto. Participating honestly, respectfully, responsibly, and fairly in this academic community ensures that the U of T degree that you earn will be valued as a true indication of your individual academic achievement, and will continue to receive the respect and recognition it deserves.

Misrepresentation

- Falsifying or altering any documentation required by the University, including doctors note,
- Falsifying institutional documents or grades.

The University of Toronto treats cases of academic misconduct very seriously. All suspected cases of academic dishonesty will be investigated following the procedures outlined in the Code. The consequences for academic misconduct can be severe, including a failure in the course and a notation on your transcript. If you have any questions about what is or is not permitted in this course, please do not hesitate to contact your instructor. If you are experiencing personal challenges that are having an impact on your academic work, please speak to your instructor or seek the advice of your college registrar.

Course outline

Review material

- **Review**
 1. Calculus: mostly taking limits, integration and sketching functions (eg. sketching $t^2 e^{-t}$).
 2. Linear algebra: computing eigenvalues and eigenvectors for 2×2 matrices.

- **New concepts that we will only skim**

1. Complex numbers and Euler's formula.
2. Taylor expansion.

Recurring themes/questions

- **Recognizing which method to apply**

1. Given a first order to identify its type: is it linear, separable, exact? Can it be made into any of these three by an appropriate integrating factor.
2. Given a second order to know how to compute the characteristic equation and identify the fundamental set of solutions based on the roots.

- **Systems of 2d equations**

1. Computing the eigenvectors for various 2×2 matrices.
2. Doing a stability analysis based on the solution you obtained.

- **Stability analysis**

1. What is the asymptotic behaviour of the solution as time goes to infinity?
2. Classify each of the equilibrium solutions: asymptotically stable/unstable, saddle/sink/source.