MATH_V 256 101 2024W1 Differential Equations

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Brief Description

This course provides an introduction to solution methods for ODEs for engineering students. Topics include

I. First-order ODEs (integrating factors, separable equations)
II. Second-order, constant coefficient ODEs (real, repeated and complex roots; homogeneous and inhomogeneous)
III. Systems of ODEs
IV. Laplace Transform methods
V. Fourier series
VI. Solution of partial differential equations by separation of variables

Quick links

- Time/Location: M/W/F 12:00-12:50pm, SCRF 100
- Weekly readings and lecture notes are posted here: **Readings and Lecture Notes (https://canvas.ubc.ca/courses/149717/pages/readings-and-lecture-notes?wrap=1)**
- Homework can be downloaded here: **Files section (https://canvas.ubc.ca/courses/149717/files/folder/Assignments)**
- Homework guidelines are here: **Homework Guidelines (https://canvas.ubc.ca/courses/149717/pages/homework-guidelines?wrap=1)**

Instructor

Miranda Holmes-Cerfon
Contact: **Canvas message system (https://canvas.ubc.ca/conversations) (https://canvas.ubc.ca/conversations)** or miranda.holmescerfon@ubc.ca
Office: Math 112
Office Hours: TBD and after class

References

There is no required textbook for the course. Some additional recommended books which cover very similar content include:

- Jiri Lebl, "Notes on Diffy Qs". Available for free online at this link: **https://www.jirka.org/diffyqs/ (https://www.jirka.org/diffyqs/)**

  - readings will be posted from this book each week
- Boyce and DiPrima, "Elementary differential equations and boundary value problems"
- Blanchard, Devaney, Hall, "Differential Equations"
- E. Kreiszig, "Advanced Engineering Mathematics"

You are *strongly encouraged* to simultaneously read at least one of these books, for extra problems and for the additional perspective. We'll post readings from "Diffy Qs" each week, but you can find the corresponding chapters in any of the other books if you prefer their style.

In addition you can find lecture notes, sample exams, video lectures, and more from past iterations of the course at this site:

- **www.math.ubc.ca/~njb/Math256.htm (http://www.math.ubc.ca/~njb/Math256.htm)**

Background Knowledge

Here are some topics you should be familiar with prior to the course.

- **a selection of background topics (https://canvas.ubc.ca/courses/149717/files/34466323?wrap=1) (https://canvas.ubc.ca/courses/149717/files/34466323/download?download_frd=1)**
- **complex numbers (https://canvas.ubc.ca/courses/149717/files/34466321?wrap=1) (https://canvas.ubc.ca/courses/149717/files/34466321/download?download_frd=1)**
- **notation (https://canvas.ubc.ca/courses/149717/files/34466322?wrap=1) (https://canvas.ubc.ca/courses/149717/files/34466322/download?download_frd=1)**

Homework

- There will be ~5 written homework assignments (roughly once every 2 weeks, except during midterm weeks)
- Access via "Assignments" Tab or in the "Files" section. They will be posted at least a week before the due date.
- Submit homework electronically on Gradescope (see left menu bar) -- please see **guidelines (https://canvas.ubc.ca/courses/149717/pages/homework-guidelines?wrap=1)**
- Some homework may require using Matlab. You should be familiar with Matlab and how to access it from your previous courses.
- Late homework will be accepted up to a maximum of 48 hours past the due date, and will be penalized 10% if within 24 hours late, and 20% if within 48 hours late.
- The lowest homework grade will be dropped.
- Tentative due dates are (these may be updated during the semester):
  - HW1: Friday Sept 20, 11:59pm
  - HW2: Friday Oct 4, 11:59pm
  - HW3: Friday Oct 25, 11:59pm

- HW4: Friday Nov 15, 11:59pm
- HW5: Friday Dec 6, 11:59pm

The homework is intended as a preliminary guide, to help you get started practising the concepts in this class, and to become familiar with the types of questions you'll encounter on the exams. For most students, it won't be enough practice. You are *strongly encouraged* to seek out other problems, in addition to the homework. Options include

- Exercises in the books above
- Webwork problems -- these will be made available for extra practice (they won't count towards your grade)
- Exercises in class -- the instructor will often give out problems in class, both to work on during class time, and to try during your own time but before the next class. Since math must be learned progressively, you are encouraged to review your notes and to work on any additional exercises before you come to each class.

Exams

There will be two in-class midterm exams and a final exam. The tentative dates are

- Midterm 1: 50 minutes, Wednesday Oct 9
- Midterm 2: 50 minutes, Wednesday Nov 20
- Final Exam: 2.5 hours, TBD by registrar

Students who miss a midterm exam for a valid reason (illness, family emergency, etc) will have their grade averaged proportionally over the other exams. If this is the case, you must submit a request for academic concession *before* the midterm (**https://www.math.ubc.ca/undergraduate/faq (https://www.math.ubc.ca/undergraduate/faq)**), and it must be approved before the midterm. (If an emergency prohibits you from submitting the form before the exam, then submit it as soon as you are capable of doing so.) Keep all documentation in case you are asked for it.

Grading

- 50% Final exam
- 17.5%/17.5% for Midterm 1 / Midterm 2
- 15% Homework

Communication

Any material and information pertinent to this course will be posted to this Canvas page, and information will additionally be announced in class. You are encouraged to subscribe to notifications so you find out about changes to the material on Canvas as soon as it happens. If there is time-sensitive information the instructor will send an announcement using Canvas -- *make sure you are*

subscribed to announcements so you get notified immediately (usually by email).

To contact the instructor with course-related information, please ask in person during or after class or during office hours. To contact the instructor with personal information, please send an email.

A Piazza site has been set up for you to discuss course material with your peers; access it using the menu bar to the left of this page. The TAs will occasionally respond to posts, but you are encouraged to discuss amongst yourselves first. Note the instructors will not monitor this site, except to monitor behaviour.

Where to get help

- Talk to instructor after class (I'll generally be available for at least 10-15 minutes after each class)
- Go to office hours (posted above)
- Post a question to Piazza (access via "Piazza" tab). You are encouraged to monitor Piazza and post questions or respond to other students' questions. The instructors and TAs will NOT access this forum; this is purely for students to discuss with each other.
- Talk with your peers in person! They're right beside you, and they also have questions but may have different kinds of insight from you.
- Reach out to the TAs. There will be at least one TA office hour per week.
- Go to the **Math Learning Centre (https://www.math.ubc.ca/undergraduate/advising-and-resources/drop-help/)** (MLC)

Collaboration policy

You are allowed to (even encouraged to) collaborate with other students on your homework and for studying. However, you must write up solutions individually and in your own words. Please indicate any group members on your individual assignment submissions.

Similarly, you may use external tools to check your work, as long as you adhere to the following guidelines:

- you must attempt each problem on your own first, and you must be able to solve the problem using the methods we learned in class
- you must write up the steps in your solution as well as your final answer
- you must write up you final answer on your own, without using technology (similar to the policy for collaborating with real people)

Weather Contingency Plan

You should check **ubc.ca (http://ubc.ca/)** often during bad weather or snow. If a class session is cancelled, class will be held online. Instructions will be posted on Canvas. For those unable to participate in the online class, I will provide a recording on Canvas. If a cancellation impacts a

midterm, we will reschedule to another class time. If the final exam is impacted, it will be rescheduled by student services. If you are registered to write exams at the Centre for Accessibility, I encourage you to contact your CFA advisor to discuss the weather contingency plan for this course.

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available on the **UBC Senate website (https://senate.ubc.ca/policies-resources-support-student-success)** .

Course Summary:

Date	Details	Due
Fri Sep 20, 2024	**Homework 1 (https://canvas.ubc.ca/courses/149717/assignments/1951964)**	due by 11:59pm
Fri Oct 4, 2024	**Homework 2 (https://canvas.ubc.ca/courses/149717/assignments/1951965)**	due by 11:59pm
Wed Oct 9, 2024	**Midterm 1 (https://canvas.ubc.ca/courses/149717/assignments/1951980)**	due by 12pm
Fri Oct 25, 2024	**Homework 3 (https://canvas.ubc.ca/courses/149717/assignments/1951966)**	due by 11:59pm
Fri Nov 15, 2024	**Homework 4 (https://canvas.ubc.ca/courses/149717/assignments/1951968)**	due by 11:59pm
Wed Nov 20, 2024	**Midterm 2 (https://canvas.ubc.ca/courses/149717/assignments/1951981)**	due by 12pm

Date	Details	Due
Fri Dec 6, 2024	Homework 5 (https://canvas.ubc.ca/courses/149717/assignments/1951969)	due by 11:59pm

Readings, Topics, and Lecture Notes

The readings below all refer to sections in the online textbook "Diffy Q's" (see syllabus), but you can find sections covering the same topics in any of the recommended textbooks.

The outline below is tentative, and subject to change.

Weekly readings, topics, and lecture notes

Dates	Reading in "Diffy Q's"	Topics	Lecture notes
Week 1: Sept 4-6	0.2, 0.3	• What is a solution to an ODE • How to check if a given function is a solution (or not) • Qualitatively predicting the solution, equilibrium solutions • Classification of ODEs: linear, nonlinear, separable, order	week 1 notes
Week 2: Sept 9-13	1.1-1.4	• Separation of variables • Integrating factors	week 2 notes
Week 3: Sept 16-20	2.1, 2.2	• how to solve second-order, linear, homogeneous ODEs with constant coefficients	week 3 notes
Week 4: Sept 23-27	2.4	• applications of second-order, linear, homogeneous ODEs (mechanical vibrations, pendulums, electric circuits)	week 4 notes
Week 5: Oct 2-4	2.5	• how to solve second-order, linear, *nonhomogeneous* homogeneous ODEs with constant coefficients • no class Sept 30	week 5 notes (https://canvas.ubc.ca/courses/149717/files/34466344?wrap=1)
Week 6: Oct 7-11	2.6	• more applications: forced oscillations, resonance, beats	week 6 notes

Week 7: Oct 16-18	3.1-3.5	• linear systems of ODEs (homogeneous) • no class Oct 14	week 7 notes
Week 8: Oct 21-25	3.6, 3.9	• second-order linear systems of ODEs • nonhomogeneous linear systems of ODEs	week 8 notes
Week 9: Oct 28-Nov 1	6.1, 6.2	• Laplace transforms: definition, computing them, inverse Laplace transform • Solving ODEs using the Laplace transform	week 9 notes
Week 10: Nov 4-8	6.3, 6.4	• solving ODEs using the Laplace transform (continued) • delta-functions	week 10 notes
Week 11(-): Nov 15	n/a	• TBD • no class Nov 11,13	
Week 11: Nov 18-22	4.2-4.5	• convolutions, transfer functions • Fourier series (intro)	week 11 notes (https://canvas.ubc.ca/courses/149717/files/34466335?wrap=1)
Week 12: Nov 25-29	4.2-4.9	• Fourier series for periodic functions • Fourier series for even & odd functions • Solving the heat equation by separation of variables	Week 12 notes
Week 13: Dec 2-6	same as above	• Heat equation with nonhomogeneous boundary conditions • Heat equation with Neuman boundary conditions	Week 13 notes