



THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science, Mathematics, Physics and Statistics  
Okanagan Campus

**MATH 100 – 101 Calculus I: Differential Calculus**  
**W2022 – Term 2**  
**COURSE OUTLINE**

**Classroom Schedule:** Tues Thurs 12:30-1:50pm

**Location:** FIP 204

**Delivery Mode:** This class is taught in-person. Notes and recordings of the lectures will often be posted on Canvas, but for full participation I expect students to be in class. Test and the final exam will be in person as well. **This is subject to change if required by public health conditions.**

**Instructor:** Dr. Wayne Broughton      **Office:** SCI 106      **Phone/Voicemail:** 250-807-9531

**Drop-in Office Hours:** Tues 11:00-12:00      Thurs 3:00-4:00

The quickest way to get a response from me is to drop in at my office hours.

**E-mail:** [wayne.broughton@ubc.ca](mailto:wayne.broughton@ubc.ca) or contact me through the Canvas messaging system for greater security.

**Calendar Description:** Derivatives of elementary functions, limits. Covers applications and modelling: graphing and optimization. Credit will not be granted for both MATH 100 and MATH 116.

*Prerequisites:* 67% or higher in Principles of Math 12 or Pre-Calculus 12, or 60% or higher in MATH 125 or MATH 126.    *Equivalency:* MATH 116

**Canvas:** Announcements, lecture notes, assignments, Zoom links, and other information will be posted on the Canvas course page. It is your responsibility to check announcements and important dates frequently. Log in at <https://canvas.ubc.ca>

**Textbooks:**

1. *CLP-1 Integral Calculus textbook* by Joel Feldman, Andrew Rechnitzer, and Elyse Yeager. This free e-text is available at <https://personal.math.ubc.ca/~CLP/CLP1> and was produced by UBC professors. This book is written at a bit of a higher level than the other text, but contains more information. Some of the exercises are more challenging.
2. *OpenStax Calculus Vol. 1*. This is an open textbook written by various authors. It can be found at this link <https://openstax.org/details/books/calculus-volume-1>. This book may be more readable and contains many exercises, though it does have some errors.

**Calculators, etc.:** No calculators or electronic devices will be allowed during tests, including computers, tablets, cell phones, and other such devices.

**iClicker Cloud (formerly iClicker Reef):** You will need an iClicker Cloud account to participate in quiz questions during class time. Please see <https://lthub.ubc.ca/guides/iclicker-cloud-student-guide/> for instructions. **Note that this is free and you do not need to purchase a Clicker device.** This will run on your mobile device.



**Course Format:** The class consists of lectures and labs. You will have online and written assignments, in-class multiple choice quiz questions, midterm tests, and a final exam. You are expected to attend all lectures and labs and stay current with the material. In order to help with this, it is a good idea to look at the topics being covered in one of the references before lecture.

**Lab Format:** Most weeks you will meet in person with your lab section and Teaching Assistant. In your lab, your TA will collect all the weekly assignments and redistribute them to the students in the lab section. The TA will then go over a selection of problems from the assignment, working through the answer and highlighting areas of importance. While the TA does this, you will be giving feedback on your classmate's assignment that you've been given. The feedback you give or receive is not for marks—it is intended to help improve your mathematical exposition. Seeing how your peers approach problems is also beneficial.

**Lab Section:** Every student must be registered in one of the lab sections. Please note your lab section number for future reference. **Labs will begin the week of January 16th, 2023.**

The lab sections and TAs for this course are listed below. They may choose to provide you their email addresses, but it is often better to contact the TAs using the Canvas messaging system for security and privacy.

L2A Wednesday 1:00 PM - 2:00 PM: Mijan	L2E Wednesday 12:00 PM - 1:00 PM: Ivona
L2B Thursday 8:00 AM - 9:00 AM: Simon	L2F Friday 11:00 AM - 12:00 PM: Ivona
L2C Wednesday 1:00 PM - 2:00 PM: Ian	L2G Friday 3:00 PM - 4:00 PM: Mijan
L2D Monday 12:00 PM - 1:00 PM: Simon	L2H Monday 11:00 AM - 12:00 PM: Ivona

### Key Dates:

Here are some important dates for the course. You can also consult the academic calendar at <http://www.calendar.ubc.ca/okanagan/index.cfm?go=deadlines>

<b>Mon, Jan 16:</b>	Labs begin this week
<b>Fri, Jan 20:</b>	Last day to withdraw without a W on your transcript
<b>Thurs, Feb 9:</b>	<b>Midterm 1</b>
<b>Feb 20–24:</b>	Midterm break (no lectures and no labs this week)
<b>Thurs, Mar 16:</b>	<b>Midterm 2</b>
<b>Fri, Mar 24:</b>	Last day to withdraw (with a W on your transcript) using the Student Service Centre
<b>Fri, Apr 7:</b>	Good Friday holiday (no classes this day; no labs this whole week)
<b>Mon, Apr 10:</b>	Easter Monday holiday (no classes this day; no labs this whole week)
<b>Thurs, Apr 13:</b>	Last lecture
<b>Apr 17–28:</b>	Final exam period

**Syllabus:**

Topics	Approx. dates	Textbook (CLP-1)
Introduction to limits	Jan 10 – 12	1.1 – 1.3
One-sided limits, infinite limits, Limit Laws	Jan 17 – 19	1.3 – 1.4
Limit calculations with algebra and limit laws, Squeeze Theorem, limits at infinity	Jan 24 – 26	1.4 – 1.5
Continuity, Intermediate Value Theorem, tangent lines	Jan. 31 – Feb 2	1.6, 2.1
Definition of derivative, interpretations of derivatives	Feb 6	2.1 – 2.3
<b>Midterm 1</b>	Feb 9	
Derivative function, differentiability, derivative rules	Feb 14 – 16	2.4, 2.6
<b>Reading week</b>	Feb 20 – 24	
Derivatives of polynomials, product and quotient rules, derivatives of exponential functions	Feb 28 – Mar 2	2.4, 2.6, 2.7
Trigonometric derivatives, Chain Rule	Mar 7 – 9	2.8 – 2.9
Inverse functions, natural logarithm, derivatives of logarithms	Mar 14	2.10
<b>Midterm 2</b>	Mar 16	
Logarithmic differentiation, inverse trig functions and derivatives, implicit differentiation	Mar 21 – 23	2.10 – 2.12
Related rates (if time), higher-order derivatives, linear approximations and differentials	Mar 28 – 30	(3.2), 2.14, 3.4.2
Local and global extrema, Fermat's theorem for critical points, intervals of increase/decrease, first derivative test	Apr 4 – 6	3.5.1 – 3.5.2, 3.6.2
Intervals of concavity, second derivative test, inflection points, curve sketching	Apr 11	3.6.3, 3.6.5-3.6.6
Optimization problems (if time)		(3.5.3)
L'Hôpital's Rule	Apr 13	3.7
Rolle's Theorem, Mean Value Theorem, Newton's method (if time)		(2.13, C.1)

**Course Objectives:** This course is a first course in differential calculus. No background in calculus is required to be successful in this course. We will provide an introduction to the techniques and theory of differential calculus and practice how to apply these techniques to model and solve various problems.

**Learning Outcomes:** Upon completion of this course, students should be able to:

- Evaluate limits graphically (estimate a limit by looking at the graph) and numerically
- Evaluate limits of functions algebraically
- Determine if a function has a vertical asymptote at a value  $x=a$ ; determine the one-sided limiting behaviour at these values
- Evaluate limits at infinity
- State the mathematical definition of continuity



- Determine values at which a function is discontinuous
- Identify removable, jump, and infinite discontinuities
- Show that certain equations have solutions using the Intermediate Value Theorem (IVT)
- State the limit definition of a derivative
- Calculate a simple derivative from the limit definition
- Determine if a function is differentiable at a point on its graph
- Calculate the derivatives of the elementary functions:
  - Polynomials
  - Rational functions
  - Root functions
  - Trigonometric functions
  - Exponential functions
  - Logarithmic functions
  - Inverse trigonometric functions
- Calculate derivatives of functions using the following differentiation rules:
  - Power rule
  - Product Rule
  - Quotient Rule
  - Chain Rule
- Find the equations of a tangent line at a point on the graph of a function
- Identify the graph of a derivative from the graph of a function
- Calculate derivatives of implicitly defined functions using implicit differentiation
- Use logarithmic differentiation to calculate derivatives of power functions
- Use l'Hôpital's Rule to calculate limits at infinity
- Solve related rates problems that model a number of real-world situations (**time permitting**)
- Calculate the linearization and differential of a function
  - Approximate a function value using the linearization
  - Approximate the change in a function using the differential
- Be able to find critical points of a function using Fermat's Theorem
- Calculate intervals of increase/decrease and intervals of concave up/concave down of a function
- Classify critical points as local minima or local maxima using the First Derivative Test and/or the Second Derivative Test
- Calculate inflection points of a function
- Calculate the maximum and minimum values of a continuous function over a closed interval using the Extreme Value Theorem (the closed interval method)
- Sketch a graph of a function using curve sketching methods
- Use techniques for finding maxima and minima of functions to solve optimization problems that model real-world situations
- Show a polynomial has exactly one real root using Rolle's Theorem (**time permitting**)
- Prove the Mean Value Theorem from Rolle's Theorem (**time permitting**)
- Use Newton's method to approximate roots of polynomials (**time permitting**)

**Evaluation:**

iClicker Quizzes	5%
WeBWorK assignments	10%
Lab assignments	15%
Midterm tests	30%
Final exam	40%

1. **iClicker quiz questions:** During many lectures, a multiple-choice quiz problem will be given using the online iClicker Cloud app. In order to obtain full credit for this portion, it is enough to have correct responses to 50% of all of these questions (i.e., it will be scored out of only half the total assigned marks, and this is the maximum score you can get), so I will not be tracking individual exceptions for missed classes.
2. **WeBWorK assignments:** Most weeks you will have an assignment to complete using the free online homework system *WeBWorK*. Please review the syntax rules for submitting your answer, as it will not be possible to adjust assignment grades on a student-by-student basis. **No late WeBWorK assignments will be accepted.**
3. **Lab assignments:** Your lab grade will be based on:
  - 1) Completion (not correctness) of your lab assignment. It is very important that you at least try every problem and the lab TA will be looking for this.
  - 2) The quality of the feedback you give. The feedback you leave your peers should be helpful and well thought out.

You must attend your own lab in order to participate. Attending different labs will result in no marks. You also must participate in both aspects of this assignment in order to receive full marks for it. If you only hand in the weekly problem set and don't stay to mark/leave feedback, then you will get no more than 25% on that lab assignment. **Late or missed lab assignments will not be accepted. Your two lowest lab assignment marks will be dropped.**
4. **Midterms:** There will be two midterm tests **in person** during normal class time, tentatively scheduled for **Friday February 9th** and **Friday March 16<sup>th</sup>**. It is your responsibility to be present for these tests.

If you are going to miss a midterm test, you must inform me **before** the test is written with the reason for your absence in order to have the opportunity to write a makeup test. The midterm makeup test will be provided through the UBC-O Testing Services at a time and a date to be determined. There will be only **one** chance to makeup each midterm. Note that the makeup midterm is only if you missed the original test; it is not a re-write to improve your grade. If you miss the date to make up a midterm, then as described below whatever percentage grade you obtain on the portion of the final exam that corresponds to that midterm will become your midterm grade.



The final exam will come in three parts. Part A covers the material on Midterm 1 and part B covers the material on Midterm 2. **If you score better on part A then you did on the midterm, then I will replace your midterm grade with your grade on part A of the final exam, and similarly for part B.**

- 5. Final exam:** There is a 2.5-hour comprehensive final exam during the final examination period from April 17 to 28 (including possibly weekends or evenings). **The final exam is in person.** Please note the date and time of the final exam when these are announced. You must obtain permission from the Dean's office to miss or reschedule the exam for any valid reason (with documentation); more information is below. **Failure to attain a mark of at least 35% on the final exam will result in a failing grade for the course, as will missing the exam without permission. If you would have otherwise passed the course, your grade will be recorded as 45%.**

Final grades will be based on the evaluations listed above and the final grade will be assigned according to the standardized grading system outlined in the UBC Okanagan Calendar.

### **General Tips:**

You are responsible for getting the most out of your education. That means taking an active approach to learning. Calculus can be tricky, and requires a lot of effort on your part. No one can understand it for you. For each hour of class time, you can expect to put in 2-3 hours of time outside of class to study the course material. My expectation is that all students in this course do as many practice problems as they can to solidify their knowledge of the material. The amount of practice needed will vary from student to student. On the other hand, it is our job to do what we reasonably can to help you learn. If there are specific things you are having trouble understanding, don't hesitate to ask for help. Your friends, the Internet, your TAs, and even your professor can clear up something in 5 minutes which you might otherwise spend several discouraging hours trying to understand.

Do not allow yourself to fall behind, wishfully thinking you can catch up later. There is a LOT of content to cover. If you find you are having difficulty keeping up, then do something about it immediately. See me or your TA if you need extra help.

Your textbook is a valuable tool. It contains alternative descriptions and examples of all of the content we will cover. Keep in mind, however, that reading a math textbook is a laborious process. You might read each section three or four times before you understand how everything fits together.

By its very nature, mathematics can only be learned by doing it. To be most effective, you should: *read ahead*, attend lectures and labs, *review* your notes, and do all the *practice problems* you possibly can! This may sound like a lot of work for each class, but it really does make a difference.

- You should not expect to immediately master every topic and/or know how to solve every problem you are confronted with immediately or after attending one lecture on a particular topic. You *must*



practice and learning the material *will* take time.

- You should expect to get stuck on problems in this course. This is actually the best thing that can happen in mathematics. Getting yourself “unstuck” is the absolute best way to learn.

## COVID-19

I am sure we are all happy to be back on campus and see the COVID restrictions lifted, including mask mandates. However, new variants of the virus continue to circulate in the community and it is wise to be cautious.

- I strongly recommend that everyone who is eligible get vaccinated in order to help protect yourself and others.
- I plan on wearing a mask in the classroom, and recommend that you do so as well, for everyone’s safety.
- Please conduct daily health assessments. You can find a tool to help you do this here: <https://bc.thrive.health/covid19/en>
- Stay home when feeling sick; even if you are feeling a little unwell, then please stay home and do not come to campus. Contact me as soon as possible and **I will do my best to provide academic accommodations to you so that you do not fall behind.**
- It is extremely important that a culture of respect for one another is maintained, whether you choose to wear a mask or not. And remember that not everyone exhibiting COVID symptoms necessarily has COVID. There are many conditions that can lead to a chronic dry cough or other symptoms, such as allergies. Please keep this in mind and trust that your classmates are doing their daily self-assessments and that they will stay home if they feel unwell.

## Grading Practices

Faculties, departments, and schools reserve the right to scale grades in order to maintain equity among sections and conformity to university, faculty, department, or school norms. Students should therefore note that an unofficial grade given by an instructor might be changed by the faculty, department, or school. Grades are not official until they appear on a student's academic record.

<http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014>

## Final Examinations

The examination period for W2022 Term 2 is **Monday April 17<sup>th</sup> to Friday April 28<sup>th</sup>, 2023**. Except in the case of examination clashes and hardships (three or more formal examinations scheduled within a 24-hour period) or unforeseen events, students will be permitted to apply for out-of-time final examinations only if they are representing the University, the province, or the country in a competition or performance; serving in the Canadian military; observing a religious rite; working to support themselves or their family; or caring for a





family member. Unforeseen events include (but may not be limited to) the following: ill health or other personal challenges that arise during a term and changes in the requirements of an ongoing job.

Further information on **Academic Concession** can be found under **Policies and Regulation in the Okanagan Academic Calendar** <http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0>

## Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. *The use of artificial intelligence (AI) assistance or online tutoring services for any assessed portions of this course is not permitted.*

Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar at: <http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0>.

## Cooperation vs. Cheating

Working with others on assignments is a good way to learn the material and we encourage it. However, there are limits to the degree of cooperation that we will permit. Any level of cooperation beyond what is permitted is considered cheating.

When working on written or programming assignments, you must work only with others whose understanding of the material is approximately equal to yours. In this situation, working together to find a good approach for solving a problem is cooperation; listening while someone dictates a solution is cheating. You must limit collaboration to a high-level discussion of solution strategies, and stop short of actually writing down a group answer. Anything that you hand in, whether it is a written problem or a computer program, must be written by you, from scratch, in your own words. If you base your solution on any other written solution, you are cheating. If you provide your solution for others to use, you are also cheating.

## Copyright Disclaimer

Diagrams and figures included in lecture presentations adhere to Copyright Guidelines for UBC Faculty, Staff and Students <http://copyright.ubc.ca/requirements/copyright-guidelines/> and UBC Fair Dealing Requirements for Faculty and



Staff <http://copyright.ubc.ca/requirements/fair-dealing/>. Some of these figures and images are subject to copyright and will not be posted to **Canvas**. All material uploaded to **Canvas** that contain diagrams and figures are used with permission of the publisher; are in the public domain; are licensed by Creative Commons; meet the permitted terms of use of UBC's library license agreements for electronic items; and/or adhere to the UBC Fair Dealing Requirements for Faculty and Staff. Access to the **Canvas** course site is limited to students currently registered in this course. Under no circumstance are students permitted to provide any other person with means to access this material. Anyone violating these restrictions may be subject to legal action. Permission to electronically record any course materials must be granted by the instructor. Distribution of this material to a third party is forbidden.

## Grievances and Complaints Procedures

A student who has a complaint related to this course should follow the procedures summarized below:

- The student should attempt to resolve the matter with the instructor first. Students may talk first to someone other than the instructor if they do not feel, for whatever reason, that they can directly approach the instructor.
- If the complaint is not resolved to the student's satisfaction, the student should e-mail the Associate Head, Dr. Sylvie Desjardins, at [sylvie.desjardins@ubc.ca](mailto:sylvie.desjardins@ubc.ca) or the Department Head, Dr. John Braun, at [cmps.depthhead@ubc.ca](mailto:cmps.depthhead@ubc.ca)

## Student Service Resources

### Disability Resource Centre

The Disability Resource Centre ensures educational equity for students with disabilities and chronic medical conditions. If you are disabled, or have an injury or illness, and require academic accommodations to meet the course objectives, please contact Earllene Roberts, the Diversity Advisor for the Disability Resource Centre located in the University Centre building

**UNC 215** Web: [www.students.ok.ubc.ca/drc](http://www.students.ok.ubc.ca/drc) Phone: 250.807.9263 E-mail: [earllene.roberts@ubc.ca](mailto:earllene.roberts@ubc.ca)

### Equity and Inclusion Office

Through leadership, vision, and collaborative action, the Equity & Inclusion Office (EIO) develops action strategies in support of efforts to embed equity and inclusion in the daily operations across the campus. The EIO provides education and training from cultivating respectful, inclusive spaces and communities to understanding unconscious/implicit bias and its operation within in campus environments. UBC Policy 3 prohibits discrimination and harassment on the basis of BC's Human Rights Code. If you require assistance related to an issue of equity, educational programs, discrimination or harassment please contact the EIO.

**UNC 325H** Phone: 250-807-9291 Web: <https://equity.ok.ubc.ca/> E-mail: [equity.ubco@ubc.ca](mailto:equity.ubco@ubc.ca)

*I have personally been involved in the Equity and Inclusion Office's Positive Space program, which works on raising awareness about homophobia and transphobia on campus, and on my department's Equity, Diversity and Inclusion committee. I believe that the university should be a place where students feel respected and welcome, regardless of race, ethnicity or national origin, religion, gender or gender identity, and sexual orientation. Please feel free to come see me if you need someone to talk to.*

### Office of the Ombudsperson for Students

The Office of the Ombudsperson for Students is an independent, confidential and impartial resource to ensure students are



treated fairly. The Ombuds Office helps students navigate campus-related fairness concerns. They work with UBC community members individually and at the systemic level to ensure students are treated fairly and can learn, work and live in a fair, equitable and respectful environment. Ombuds helps students gain clarity on UBC policies and procedures, explore options, identify next steps, recommend resources, plan strategies and receive objective feedback to promote constructive problem solving. If you require assistance, please feel free to reach out for more information or to arrange an appointment. **UNC 328** Phone: 250-807-9818 E-mail: [ombuds.office.ok@ubc.ca](mailto:ombuds.office.ok@ubc.ca) Web: [www.ombudsoffice.ubc.ca](http://www.ombudsoffice.ubc.ca)

### **Sexual Violence Prevention and Response Office (SVPRO)**

A safe and confidential place for UBC students, staff and faculty who have experienced sexual violence regardless of when or where it took place. Just want to talk? We are here to listen and help you explore your options. We can help you find a safe place to stay, explain your reporting options (UBC or police), accompany you to the hospital, or support you with academic accommodations. You have the right to choose what happens next. We support your decision, whatever you decide. Visit [svpro.ok.ubc.ca](http://svpro.ok.ubc.ca) or call us at 250-807-9640

### **Independent Investigations Office (IIO)**

If you or someone you know has experienced sexual assault or some other form of sexual misconduct by a UBC community member and you want the Independent Investigations Office (IIO) at UBC to investigate, please contact the IIO. Investigations are conducted in a trauma informed, confidential and respectful manner in accordance with the principles of procedural fairness. You can report your experience directly to the IIO by calling 604-827-2060.

Web: <https://investigationsoffice.ubc.ca/>

E-mail: [director.of.investigations@ubc.ca](mailto:director.of.investigations@ubc.ca)

### **Student Learning Hub**

The Student Learning Hub is your go-to resource for free math, science, writing, and language learning support. The Hub welcomes undergraduate students from all disciplines and year levels to access a range of supports that include **tutoring in math, sciences, languages, and writing, as well as help with study skills and learning strategies.**

**LIB 237**

Web: <https://students.ok.ubc.ca/student-learning-hub/>

Ph: 250-807-9185.

### **Student Wellness**

At UBC Okanagan, health services to students are provided by Student Wellness. Nurses, physicians and counsellors provide health care and counselling related to physical health, emotional/mental health and sexual/reproductive health concerns. As well, health promotion, education and research activities are provided to the campus community. If you require assistance with your health, please contact Health and Wellness for more information or to book an appointment.

**UNC 337**

Web: [www.students.ok.ubc.ca/health-wellness](http://www.students.ok.ubc.ca/health-wellness) Ph: 250-807-9270

Email: [healthwellness.okanagan@ubc.ca](mailto:healthwellness.okanagan@ubc.ca)

**SAFEWALK** *Don't want to walk alone at night? Not too sure how to get somewhere on campus? Call Safewalk at 250-807-8076. For more information, see: [www.security.ok.ubc.ca](http://www.security.ok.ubc.ca)*