## MATH 101-103: Integral Calculus with Applications to Physical Sciences and Engineering

**Instructor(s):** Dr. Javad Tavakoli

**Instructor email:** Javad.tavakoli@ubc.ca

**Duration:** Term 2 Winter 2022

**Delivery Modality:** In-person

**Course Location:** EME 0050

**Course Days:** Mon Wed

**Class Hours:** 6:30 PM – 8:00 PM

**Office hours:** MW from 5:00pm to 6:20pm

**Lab TAs**

The lab TAs for this course and their UBC emails are listed below. It is generally better to contact the TAs using the Canvas messaging system as there may be certain things they can not answer on email.

Lydia Lee; email: lydialee.lee@ubc.ca

Sanuri Hewa Thudallage; email: zanubi@mail.ubc.ca

Indira Mishra; email: imishr01@mail.ubc.ca

Nick Rieske; email: nrieske@alumni.ubc.ca

Michael Zhao; email: mzhao002@student.ubc.ca

Stephanie Busse; email: sbusse@student.ubc.ca

**The lab sections each TA is teaching are given below.**

L2A Friday 3:00 PM - 4:00 PM: Lydia

L2B Monday 5:00 PM - 6:00 PM: Sanuri

L2C Monday 8:00 AM - 9:00 AM: Indira

L2D Wednesday 5:00 PM - 6:00 PM: Nick

L2E Wednesday 11:00 AM - 12:00 PM: Indira

L2F Friday 4:00 PM - 5:00 PM: Sanuri

L2G Tuesday 1:00 PM - 2:00 PM: Lydia

L2H Thursday 10:00 AM - 11:00 AM: Michael

L2I Monday 10:00 AM - 11:00 AM: Michael

MATH 101-101: Integral Calculus with Applications to Physical Sciences and Engineering
04, Jan 2023

L2J Tuesday 11:00 AM - 12:00 PM: Lydia

L2K Wednesday 2:00 PM - 3:00 PM: Stephanie

L2L Friday 4:00 PM - 5:00 PM: Indira

L2M Monday 11:00 AM - 12:00 PM: Michael

L2N Wednesday 4:00 PM - 5:00 PM: Indira

L2O Monday 8:00 AM - 9:00 AM: Nick

L2P Friday 11:00 AM - 12:00 PM: Stephanie

L2Q Friday 10:00 AM - 11:00 AM: Stephanie

L2R Wednesday 4:00 PM - 5:00 PM: Nick

L2S Wednesday 10:00 AM - 11:00 AM: Lydia

L2T Monday 2:00 PM - 3:00 PM: Stephanie

L2V Thursday 1:00 PM - 2:00 PM: Stephanie

## Course Description

**Academic calendar entry:** Definite integral, integration techniques, applications, modelling, linear ODE's. Credit will be granted for only one of MATH 101 or MATH 142.

## Calculator Policy

No calculators of other electronic devices are allowed during tests, including computers, cell phones, tablets, smart watches, or other such devices that can send/receive communication.

## Course Format

This course is being offered in an in-person format only. All examinations and labs must be completed in-person. There are no online options.

## Course Overview, Content and Objectives

This course is a first course in integral calculus and is meant to be a sequel to a course in differential calculus. No background in integral calculus is required to be successful in this course, though you do need a course in differential calculus. We will provide an introduction to the techniques and theory of integral calculus and will see these techniques applied to the physical sciences. Some topics include:
- Riemann sums and limit definitions of integrals
- Fundamental Theorem of Calculus
- Various integration techniques for calculating indefinite and definite integrals
- Convergence and divergence of improper integrals
- Applications of integrals: Net Change Theorem, areas between curves, volumes of surfaces of revolution, solutions to first order, separable differential equations
- Convergence and divergence of various infinite series
- Power series representations of functions

If time permits, some additional topics will also be covered. These may include arc length of curves, average values of functions, numerical integration rules (trapezoid and Simson's Rule), trigonometric substitution for integration, or additional convergence/divergence tests for infinite series.

## Learning Outcomes

At the end of the semester, the student should be able to solve a number of non-trivial problems in the above listed areas, such as:

- Approximate area under a function using left and right endpoint Riemann sums
- Write a Riemann sum as a definite integral and vice versa
- Use FTC to calculate derivatives of definite integrals with functions in the limits
- Use linearity properties of integrals to calculate definite integrals
- Given a definite/indefinite integral, determine an appropriate method of integration to solve the integral. Such methods include
  ◦ $u$-substitution
  ◦ Integration by parts
  ◦ Trigonometric integrals
  ◦ Partial fractions
- Use the Net Change Theorem to solve word problems involving rates of change (Integrate the Rate)
- Calculate type 1, improper integrals and know when they converge or diverge (type 2 and mixed improper integrals will be covered **provided there is time**)
- Use the Integral Comparison Test to show when an improper integral converges or diverges (**provided there is time**)
- Solve first order, linear, separable ordinary differential equations (isolate and integrate)
- Logistic models  (**provided there is time**)
- Determine convergence/divergence of a sequence
- Find the sum of an infinite geometric series and its radius of convergence
- Determine if a $p$-series is convergent or divergent
- Determine if a given infinite series is convergent or divergent using an appropriate test. Such tests include:
  ◦ Divergence Test
  ◦ Series Comparison Test
  ◦ Limit Comparison Test
  ◦ $p$-Series Test
  ◦ Ratio Test
- Use geometric series to calculate the power series representation of a function
- Calculate the radius of convergence of a power series representation of a function using either geometric series of the Ratio Test
- Find the Taylor or MacLaurin series of a function
- Use the Taylor or MacLaurin series of a function to determine a limit or integral involving that function (**provided there is time**)

  In addition to these topics, students will be expected to develop some basic skills involving mathematical proof. At the end of the semester, the students should be able to read, understand,

and construct proofs of various simple, yet non-trivial statements related to the course material.

## Assessments of Learning

Lab assignments: 15%
Webwork Assignments 10%
Midterms (2): 30% (Feb 08, Mar 15)
Final Exam: 45%

**Final Exam:** the final exam will come in three parts: A, B, and C. Part A covers the material on midterm 1, 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. Similarly, for part B. If you miss writing one of the midterms, your grade on the corresponding portion of the final exam will be the corresponding midterm grade.

Only the **best seven** lab assignments count towards your final grade.

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.

## Learning Activities

You are expected to attend all lectures and labs and stay current with the material. It order to help with this, it is a good idea to look at the topics being covered in one of the references before lecture.

There are weekly lab sessions in this course. In your lab, your lab TA will collect your weekly problem sets and redistribute them to your peers. The TA will then go over a selection of problems from the problem set, working through the answer and highlighting areas of importance. While the TA does this, you will be giving feedback on the assignment you've been given. The feedback you receive is not for marks – it is intended to help improve your mathematical exposition. Seeing how your peers approach problems is also beneficial.

What you will be marked on is the following:
1. A mark out of 2 for completion of the weekly problem set. This is a completion mark only, you will not be marked on correctness. It is very important that you at least try every problem and the lab TA will be looking for this.
2. A mark out of 2 for the quality of the feedback you give. The feedback you leave your peers should be helpful and well thought out. Simply writing something like "good" for every question is not considered good feedback.

You must attend your own lab in order to participate. Attending different labs will result in no marks. If you choose to only do the written part of the assignment for completion, then you will receive **at most ¼** for that lab assignment.

## Course schedule

| Subject | Approximate date |
| --- | --- |
| Riemann sums | Jan 9, 11 |
| Definite integrals, antiderivatives, FTC | Jan 11, 16, 18 |

MATH 101-101: Integral Calculus with Applications to Physical Sciences and Engineering
04, Jan 2023

| | |
|---|---|
| Indefinite integrals | Jan 23 |
| Net Change Theorem | Jan 25 |
| *u*-substitution | Jan 25, 30 |
| Areas between curves, volumes | Feb 01, 05 |
| **Midterm 1** | **Feb 08** |
| Integration by parts | Feb 13, 15 |
| **Reading week** | **Feb 20, 24** |
| Trigonometric integrals | Feb 27, Mar 01 |
| Integration using partial fractions | Mar 01, Mar 06 |
| Improper integrals | Mar 06, 08 |
| Solutions to first order, separable ordinary differential equations | Mar 08, 13 |
| **Midterm 2** | **Mar 15** |
| Introduction to sequences and infinite series | Mar 20 |
| Convergence and divergence tests for infinite series | Mar 22, 27, 29 |
| Power series representations of functions and radii of convergence | Apr 03, 05 |
| Taylor and MacLaurin series | Apr 10, 12 |

## Late policy

If you can not make your lab, then you will not be eligible to participate in the lab that week. There are no makeup lab assignments.

There are no extensions for the Webwork assignments. You will be given ample time to do them and they will not be reopened.

## Missed exam policy

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 only be **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 rewrite a midterm, then as described below, whatever percentage grade you obtain on the portion of the final exam that corresponds to that midterm will be your midterm grade.

## Passing/Grading Criteria

In order to pass this course, two things need to happen.

1. You **must** attain at least 35% on the final examination;
2. You **must** attain at least 50% overall in the course.

MATH 101-101: Integral Calculus with Applications to Physical Sciences and Engineering
04, Jan 2023

Failure to complete both of these conditions will result in a failing grade for the course. In particular, if you score less than 35% on the final exam but have more than 50% in the course, then you will receive a grade of 45% for this course.

## Learning Materials

There are a few different references we will use throughout the semester.
1. *OpenStax Calculus Vol 2*. This is an open textbook written by various authors. It can be found at this link: https://openstax.org/details/books/calculus-volume-2. This book is written at a good level for first year calculus students and contains many useful exercises.
2. *CLP-2 Integral Calculus* by Joel Feldman, Andrew Rechnitzer, and Elyse Yeager. This is an open textbook found at this link: https://personal.math.ubc.ca/~CLP/CLP2/clp_2_ic/index.html. This free text has been created by UBC professors. It is written at a little bit of a higher level than the OpenStax text, but contains more information. The exercises are not as plentiful and pose more of a challenge, but are still very worthwhile to work through.
3. Integral calculate notes that I have created for this course. The structure of the class will follow these notes. The material starts in Chapter 5.
4. In addition, if you can find a copy of James Stewart's *Calculus: Early Transcendentals* then this is also a very good resource. Any edition will do. It is not necessary to have this reference.

### Some Advice

Math is hard – very cool, but hard – and it is learned via active participation and not through silent observation. The vast majority of your learning in this course will come from solving problems. Therefore, 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. For some students, simply coming to lecture, and doing the assignments might be enough. However, from my experience, most students need more that this. I have found that the formula for success for many students involves:
1. Attending lecture regularly and participating/taking notes
2. Attending the labs
3. Doing the Webwork assignments and weekly practice sets for lab *honestly*; this means not looking up answers on the internet or getting the answers from someone else.
4. Doing more practice problems outside of what is assigned for marks

I will provide you with a list of problems that I think are good to do for the sections we're covering in the text. The expectation is that you will determine how many of these you need to do in order to adequately familiarize yourself with the material.

I also think it is worthwhile to discuss here some expectations that you should have for yourself and this course, and something things that you should not expect.
1. The only materials you should expected to see on a test are those that I cover in class unless it is **explicitly stated otherwise**. In this case, there would be assigned reading or homework problems.
2. You **will** be provided with all of the necessary tools to sole all the questions that you are asked on a test.

3. 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.

4. 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.

5. You should not expect to have to know anything about integral calculus prior to taking this course in order to succeed. I will teach everything in this course without assuming any prior knowledge of integral calculus and will only assume a working knowledge of differential calculus (though if you've seen some integral calculus before, it certainly will make the content in this course easier).

## Other Course Policies

### 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. 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 usually result in a failing grade or mark of zero on the assignment or in the course.** Careful records are kept to monitor and prevent recidivism.

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

The use of artificial intelligence (AI) assistance –such as the ChatGPT bot -- for any assessed portions of this course is **not** permitted.

### Final Examinations

You can find the Senate-approved term and examination dates here. Except in the case of examination clashes and hardships (three or more formal examinations scheduled within a 27-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

**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

## Resources to Support Student Success:

**UBC Okanagan Disability Resource Centre**

The DRC facilitates disability-related accommodations and programming initiatives to remove barriers for students with disabilities and ongoing medical conditions. If you require academic accommodations to achieve the objectives of a course please contact the DRC at:

**UNC 215**        250.807.8053
Email: drc.questions@ubc.ca

Web: www.students.ok.ubc.ca/drc

**UBC Okanagan 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**        250.807.9291
Email: equity.ubco@ubc.ca

Web: www.equity.ok.ubc.ca

**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 Student Wellness for more information or to book an appointment.

**UNC 337**        250.807.9270

Email: healthwellness.okanagan@ubc.ca

Web: www.students.ok.ubc.ca/health-wellness

### Office of the Ombudperson

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**     250.807.9818

Email: ombuds.office.ok@ubc.ca

Web: www.ombudsoffice.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**. Students are encouraged to visit often and early to build the skills, strategies and behaviors that are essential to being a confident and independent learner. For more information, please visit the Hub's website.

**LIB 237**     250.807.8491

Email: learning.hub@ubc.ca

Web: www.students.ok.ubc.ca/slh

### The Global Engagement Office

The Global Engagement Office provides advising and resources to assist International students in navigating immigration, health insurance, and settlement matters, as well as opportunities for intercultural learning, and resources for Go Global experiences available to all UBC Okanagan students, and more.

Come and see us – we are here to help! You may also contact geo.ubco@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