*We recognize and acknowledge that McMaster University meets and learns on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the “Dish With One Spoon” wampum, an agreement amongst all allied Nations to peaceably share and care for the resources around the Great Lakes.*

# ISCI 2A18

**MATH COMPONENT OUTLINE**

|  |  |
| --- | --- |
|  | **Instructor:** Dr. Ben Bolker |  **E-mail:** bolker@mcmaster.ca  **Office:** Hamilton Hall 314 | **Office hours (fall term):** Thursday 11:30-12:20 (HH 314), or by appointment  **Lectures:**  Mondays 9:30-10:20am (ETB 228) & Fridays 12:30-1:20pm (HH 104) **or** 3:30-4:20 pm (ABB 163); **tutorials** 12:30-1:20pm HH 104, specified weeks  **TA:** Alec Macdonald |  **E-mail:** macdoa65@mcmaster.ca  **Office hours (fall term):** TBA |

## COMPONENT DESCRIPTION

The math portion of ISCI 2A18 extends integral calculus from the two-dimensional world of single variable functions to higher dimensions; the main focus is understanding how the fundamental theorem of calculus generalizes to this new setting. The course covers multiple integrals, parametric curves and surfaces, line and surface integrals, conservative fields, and the integral theorems of Green, Stokes and Gauss. While the emphasis is placed on the geometric and physical interpretation of these concepts and results, applications of multivariable calculus to natural and social sciences are also discussed. As part of the integration with the other ISCI 2A18 components, the course may touch on additional topics such as Fourier series, partial differential equations, and multivariate probabilities and statistics.

**Topics.** The sequence of topics covered is as follows:

* Vector functions, space curves. Arc length, curvature. Surfaces and tangent planes.
* Double and triple integrals with applications. Cylindrical and spherical coordinates.
* Vector fields. Gradient fields. Divergence and curl.
* Line integrals. Surface integrals. Applications.
* The Fundamental Theorem for Line Integrals. Green's, Stokes' and Gauss' theorems.

**TEXTBOOK AND SOLUTION MANUAL**

* J. Stewart, D. Klegg, S. Watson: *Calculus: Early Transcendentals*, Brooks/Cole (9th edition)
* *Student Solutions Manual, Chapters 12-16 for Stewart/Clegg/Watson's Multivariable Calculus*, Brooks/Cole (9th edition) – recommended

## LEARNING OBJECTIVES

The objective is to gain a working knowledge and proficiency for both the theoretical basis and range of applications of the main theorems in vector analysis.

After completing this course, students should have developed:

1. The ability to describe the motion of objects through space and determine arclength, speed, velocity and acceleration.
2. The ability to set up and compute multiple integrals in rectangular, polar, cylindrical and spherical coordinates, as well as the ability to change variables in multiple integrals.
3. The ability to set up and evaluate integrals along paths and line integrals for work.
4. The ability to set up and evaluate integrals along surfaces and flux integrals.
5. An understanding of the geometric and physical interpretations of line and surface integrals.
6. An understanding of the major theorems of this course (fundamental theorem for line integrals, Green's, Stokes', and Gauss') and the ability to apply these theorems to various geometric and physical contexts.
7. Elective research & scientific communication skills.

**TENTATIVE SCHEDULE**

Please see the *Schedule* and *Homework* links on our external webpage.

## CLASS ACTIVITIES

**Scheduled iConS**: (Integrated Concept Seminars): We have two 50-minute lectures scheduled each week. You are encouraged to take detailed notes and participate actively in the lectures. For each topic, there are suggested problems from the textbook indicated; you are strongly encouraged to work through those problems on your own or in groups following each iConS. Solutions for these exercises are available in the student solutions manual.

**Tutorials**: We have one, 50-minute meeting scheduled every other week. Tutorials will cover additional examples and present strategies for problem solving. You are welcome to ask other questions in tutorial, either about the suggested problems or other topics covered in lecture. Every fourth week (or so), there will be a short quiz (about 20 minutes) given in tutorial.

## ASSESSMENT

As indicated in the ISCI 2A18 course outline, the mathematics component contributes 35 points out of the total 300 points determining your final grade in ISCI 2A18. The composition of your final mark for the mathematics component is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Activity** |  | **Date** | **Points** |
| *Continuous*  **Attendance**  **Quizzes**  **8** **Online Assignments**  **Project** (group or individual) | Ongoing  Ongoing  Ongoing  Ongoing |  | 3  7  6  4 |
| **Midterm Exam** (December) **Final Exam** (April) | TBD TBD |  | 6  9 |
| **Total** |  |  | **35** |

*Please note: I reserve the right to change the weight of any portion of this grading scheme. If other formulas are to be considered, your final grade will not be less than the result of the scheme given above.*

Each term I will drop the lowest quiz mark and the lowest assignment mark.

**Pass-fail criteria for the mathematics component:**

A student will pass the math component of ISCI 2A18 only if they satisfy the following criteria:

* Passes the final exam (at least 50%) or receives an average passing mark on the midterm and final.
* Receives a passing mark (at least 50%) on the math component overall.

## ATTENDANCE

In recognition of the importance of attending class and participating in the class discussion, attendance will be taken and will count towards 3 points of your math grade. The intention is that any student who regularly attends most classes will receive full marks for this. This will apply to any student who attends class regularly, or 75% of the time.

## QUIZZES

There will be **ten quizzes** throughout the year, counting towards 7 points of your math grade. Detailed information regarding the material to be covered for each quiz will be posted on the course webpage. Quizzes are 30 minutes in duration and will be written during tutorial time. A quiz that is missed without proper documentation will be graded as zero.

## ONLINE ASSIGNMENTS

There will be **eight online assignments**, which are mandatory and count towards 6 points of your math grade. The online assignments are drawn from the textbook and are to be completed on childsmath. MSAF can be used for only one online assignment during each term, and in that case the weight of the missed assignment will be automatically redistributed to the other online assignments.

|  |  |  |
| --- | --- | --- |
| **Childsmath** | **Sections from Textbook** | **Due date** |
| Assignment 1 | 13.1–13.2 | September 22, 2025 |
| Assignment 2 | 13.3–13.4 | October 6, 2025 |
| Assignment 3 | 15.1–15.4 | November 3, 2025 |
| Assignment 4 | 15.5–15.8 | November 24, 2025 |
| Assignment 5 | 15.9, 16.1–16.2 | January 20, 2026 |
| Assignment 6 | 16.3–16.4 | February 10, 2026 |
| Assignment 7 | 16.5–16.7 | March 10, 2026 |
| Assignment 8 | 16.8–16.9 | March 31, 2026 |

## PROJECTS

There will be **one math educational project** contributing to 4 points of your math grade.

For the math project, students, working individually or in groups of two, will conduct additional reading on a topic or application of multivariable calculus and prepare a short (5-10 minutes) presentation. The final deliverables of this project consist of a short in-class expository presentation (video recorded) and accompanying slides. Additional details, including project topics and due dates, will be posted on the course webpage. You will receive a mark proportional to your individual contribution to the project, and failing to participate in a project will result in the grade zero. Projects that are not submitted/presented on their due date will also be graded as zero, unless proper documentation is supplied.

## EXAMS

There will be **one midterm exam** during the December exam session and **one final exam** during the April exam session. The midterm is worth toward 6 points of your math grade, and the final exam is worth 9 points of our math grade. The exact time and location of the exams will be announced in class and posted on the course webpage. Only the standard McMaster calculator Casio fx 991MS+ is allowed during math quizzes and exams*.*

## COMMUNICATION

For any communication that is not private and might be relevant to other students (e.g. details of assignments, questions about the material) please post a question on Teams. To communicate directly for private issues, please email: Ben Bolker [bolker@mcmaster.ca](mailto:bolker@mcmaster.ca) (include “ISCI 2A18” in the subject line). It is also important that you check the Avenue and Teams daily, so that you are informed of any updates.

## OFFICE HOURS

I will hold weekly office hours (dates/times TBA) in person in my office in Hamilton Hall. I will also be available for virtual meetings in Zoom.

### Tentative Lecture Schedule

**Term 1 (class weeks start on Fridays)**

|  |  |  |
| --- | --- | --- |
| **Week** | **Lecture Topics** | **Sections in Text** |
| Sep 5 | Introduction, Fundamental Theorem of  Calculus, vectors, dot product, cross product | 12.1 – 12.4 |
| Sep 12 | Lines, planes, conic sections, quadric surfaces. Vector functions, derivatives, integrals | 12.5, 12.6  13.1, 13.2 |
| Sep 19 | Arc length and curvature, | 13.3 |
| Sep 26 | Motion in space, partial derivatives | 13.4, 14.1 – 14.5 |
| Oct 3 | Double integrals | 15.1, 15.2 |
| **Oct 11-19** | **Thanksgiving break** |  |
| Oct 24 | Double integrals, | 15.3, 15.4 |
| Oct 31 | Applications, Surface area | 15.4, 15.5 |
| Nov 7 | Triple integrals | 15.6 |
| Nov 14 | Triple integrals in cylindrical coordinates | 15.7 |
| Nov 21 | Triple integrals in spherical coordinates | 15.8 |
| Nov 28 | Change of variables in multiple integrals | 15.9 |
| Dec 1 (Monday) | Review | Classes end Dec 4 |
|  |  |  |
|  |  |  |
| **Week** | **Lecture Topics** | **Sections in Text** |
| Week 1 | Vector fields, Line integrals | 16.1 |
| Week 2 | Line integrals | 16.2 |
| Week 3 | Fundamental theorem for line integrals | 16.3 |
| Week 4 | Fundamental theorem for line integrals | 16.3 |
| Week 5 | Green’s theorem | 16.4 |
| Week 6 | Divergence and curl | 16.5 |
| **Feb 14-22** | **Reading Week** |  |
| Week 7 | Parameterized surfaces and their area | 16.6 |
| Week 8 | Surface integrals | 16.7 |
| Week 9 | Surface integrals | 16.7 |
| Week 10 | Stokes’ Theorem | 16.8 |
| Week 11 | Divergence Theorem | 16.9 |
| Week 12 | Review |  |
|  | Review | Classes end Apr 7 |