Math 2575 Course Outline

Sean Fitzpatrick
University of Lethbridge

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1 Introduction to Math 2575

Welcome to Math 2575, Accelerated Calculus III. I'm happy to have you here with me as we complete the final semester of calculus. In my opinion, the last chapters in the calculus sequence are the most interesting, so you're in for a treat!

There are many of us in this class, coming from many different backgrounds and situations. I want my classroom to be as inclusive as possible. If the "default settings" for the class don't work for you, please don't hesitate to ask for accommodation. Some accommodations will be universally available, in recognition of the fact that the pandemic is not, in fact, over.

We begin with some introductions: to the university, to the staff, and to the course.

1.1 Welcome to the University of Lethbridge

Oki, and welcome to the University of Lethbridge. Our University's Blackfoot name is Iniskim, meaning Sacred Buffalo Stone. The University of Lethbridge acknowledges and deeply appreciates the Siksikaitsitapii peoples' connection to their traditional territory. We, as people living and benefiting from Blackfoot Confederacy traditional territory, honour the traditions of people who have cared for this land since time immemorial. We recognize the diverse population of Aboriginal peoples who attend the University of Lethbridge and the contributions these Aboriginal peoples have made in shaping and strengthening the University community in the past, present, and in the future.

As usual, everything you need to know for the course will flow through our Moodle[1] learning management system. Make sure you check in regularly to keep on top of what's happening in the course. (Possibly the hardest part of learning online is keeping track of deadlines.)

Don't hesitate to reach out if you have questions. I'll do my best to answer all of your course-related questions as quickly as possible. (See Section 3 for details on how to get in touch.) If you have questions that are not related to the course, you can ask those too, and I'll try to answer, or to direct you to someone who can. Some resources can be found on the University's Health and Safety website[2].

1.2 Course staff and contact information

My name is Sean Fitzpatrick[3]. I can be reached via email at sean.fitzpatrick@uleth.ca[4].

Office hours: you are not going to get everything you need during class time. I will be available throughout the week for consultation, either one-on-one, or in small groups. Monday through Thursday, you can book appointments using Calendly. You'll find the links for booking appointments on Moodle.

[1] `moodle.uleth.ca`
[2] `www.uleth.ca/services-for-students/health-safety`
[3] `www.cs.uleth.ca/~fitzpat`
[4] `mailto:sean.fitzpatrick@uleth.ca`

1.3 Course description

Math 2575 deals with the calculus of vectors, and functions of several variables. We begin with vectors, and vector valued functions, before moving on to several variables, and then finally, combining the two at the end. Just like in one variable, differentiability corresponds to the existence of a linear approximation. We'll then explore multivariable versions of familiar topics, like critical points, extrema, and optimization.

Since Math 1410 is a prerequisite for this course, we can do a few things that don't always make it into a standard calculus course. (At many universities, linear algebra is taken *after* the calculus sequence is complete.) In particular, we'll be able to make better sense of the notion of linear approximation: the linear approximation to a surface is a plane; the linear approximation to a differentiable function is a matrix transformation!

We'll then move on to double and triple integrals, and finally, to vector calculus. Most of what we see in the standard curriculum for vector calculus was developed to deal with problems in Physics, and in particular, electrodynamics. Those of you who have done a course or two in Physics will hopefully be able to make some connections.

2 Essential course information

This section covers essential course information, including the meeting times, textbook, and grading scheme.

2.1 Course website

The primary course website is Moodle[1]. On Moodle, you can expect to find:

1. Links to important resources, like this syllabus, and the textbook.
2. Links to key course activities, including the online homework, and the discussion forum. (The links will log you into those services automatically.)
3. Details about your grades and assessments.
4. A weekly topics schedule.

In case there's a day when Moodle isn't working properly and you need access to course materials, you can find some of them (like this syllabus) on my personal website[2]. The textbook for this course (and many others) is available on our Open Textbook Server[3].

2.2 Scheduled classes

All of our classes will involve synchronous instruction. If necessary, this will take place online, but we hope to do most of it in person. We meet Monday and Wednesday at 3:00 pm, and the assigned classroom is SA7212. There is also a tutorial, which meets every Friday at 1:30 pm in UHall D632.

We will be using a **team-based learning** (TBL) approach for the course. The TBL cycle works as follows:

1. The course will be divided into 4 units, corresponding to the 4 chapters we expect to cover.
2. The first class of each unit consists of a "**readiness assurance process**":

[1] `moodle.uleth.ca`
[2] `www.cs.uleth.ca/~fitzpat/teaching.html`
[3] `opentext.uleth.ca`

- You will be given a list of prerequisites needed to understand the unit, and resources to review those prerequisites.
- Class will begin with an "indvidiual readiness assurance test". This will be a multiple choice test to check your understanding of the prerequisite material.
- This test is immediately followed by a "team readiness assurance test". The team test is identical to the individual test, but done in teams.
- Once the team test is complete, teams will be asked to report their results, and we will discuss any areas where further review might be needed.

3. Note that there are ***no marks*** associated with the readiness assurance tests. They are strictly diagnostic. However, you will be asked to complete a brief reflection after each one, and you will earn credit (i.e. free marks) for doing so.

4. The remaining classes for each unit will consist of working on problems in teams. Problems will be presented in class, one at a time. For each problem, there will be time to work on it in teams, followed by time for discussion.

5. In-class problems are again ***not for marks***. They replace the usual lecture-based instruction. Students are welcome to use the textbook (and the videos it contains) to prepare in advance, or to review after the fact, but the readiness assurance process and in-class problems are meant to be sufficient for a student to learn the material.

2.3 Course textbook

Our course textbook is APEX Calculus, by Greg Hartman. This book is an **open education resource** (OER). That means that the book is fully free, both in terms of cost, your freedom to use and share the book however you see fit.

The book is availabe in both HTML and PDF formats. The HTML version[4] is recommended, as it has some nice interactive features, and works well on any device, including smartphones. The PDF is available in black and white (if you want to print it) and colour (if you want electronic access to an offline copy of the book).

2.4 Grading

I don't expect you to get everything right on your first attempt. Instead, most work that you submit will be initially graded for feedback only. If your work for a problem doesn't meet the standard for successful completion, you will be allowed to revise it and resubmit.

Your overall grade will be calculated from the following components, using the indicated weights.

Online homework (15%)	The homework will focus on building fluency with the computational procedures of calculus. You can expect a new problem set every week. Homework will be delivered through the **WeBWorK** online homework system. Homework sets will be due each Tuesday, but extensions will usually be granted. (Due dates can be considered as "best before" dates, as in, it will be best for you if you are done before the indicated date.)
Tutorials (15%)	In each week without a test, you will complete a short assignment during tutorial. These assignments can be done in groups, and you will be able to ask the tutorial instructor for assistance. Tutorial assignments will be given feedback, and graded as either satisfactory or unsatisfactory. Unsatisfactory tutorial assignments can be revised and resubmitted to receive a satisfactory grade.

[4] `opentext.uleth.ca/apex-standard/part-calculus-I.html`

Readiness assurance tests (10%) As mentioned above, you will not directly receive a mark for the tests administered during the readiness assurance process (RAP). However, after each RAP you will be asked to complete a short reflection that will be graded for completion.

Unit tests (30%) At the end of each of the four units, there will be a take-home test. The test will be provided via Crowdmark, and will be available from the end of class on Wednesday until the beginning of tutorial on Friday.
These tests are open book, but are meant to be completed *individually*. Resources such as the textbook and your notes are allowed; resources such as your friend, or some guy you paid on the internet, are not. There will be a group test following each individual test, and there is a final exam, so you will not be doing yourself (or your team) any favours if you do not attempt the tests on your own.
Revisions will also be accepted for any problems you get wrong on the unit tests.

Final exam (30%) There will be a traditional final exam in the course, during the exam period. This will be an in-person exam, but it will be open notes.

Each of the grade components above will be assigned a numerical score. These will be added to get a score out of 100. Your score out of 100 is converted into a letter grade according to the following table.

Table 2.1 Conversion of percentage scores to letter grades in Math 2575

A+	A	A-	B+	B	B-
97-100	92-96	90-91	86-89	80-85	76-79
C+	C	C-	D+	D	F
72-75	65-71	62-64	58-61	50-57	0-49

2.5 Other grading policies

A note on due dates Most due dates are flexible, and provided primarily for your benefit, to help with planning. (A course without deadlines can be a disaster for those who procrastinate.) One exception is the workshop activity before each test. Because we can't begin the peer review portion of the workshop until the submission deadline passes, we have to have a deadline for the activity to proceed.
A due date extension request form will be available via Moodle. If you need more time to complete an assessment, simply fill out the form. Unless you are contacted to say otherwise, you can assume that your request has been granted.

Revisions

For both unit tests and tutorial assignments, you will be invited to submit revisions for any incorrect work. Revisions must be submitted within ***one week*** of receiving your feedback. Tutorial revisions can be handed in during the following week's tutorial, and satisfactory revisions will raise your tutorial grade to 100%.
For test revisions, there will be a submission form available on Moodle. You may either:

1. Submit a revision for ***one*** problem, in which case your revised grade will replace the original score, or
2. Submit revisions for all problems, in which case each correct revision will earn you back 50% of the points originally lost.

Your revision must contain not only corrected work, but also a reflection on your original work:

- What was incorrect on your previous attempt?
- What factors contributed to getting the question wrong?
- What have you learned in the meantime that changed your understanding of the question?

Note that you will not be able to submit revisions for the fourth test, since we will not be able to have feedback returned to you before the end of the semester, and we cannot ask for term work to be submitted during the exam period.

Dropping lowest grades

For tutorials and online homework, your lowest two grades will be dropped. If you are unable to write one of the tests during the scheduled test window, please let me know and I will reschedule it for you.

3 Communication

The following communication channels are available in this course:

1. *Forums.*

   Given the size of this class, we will probably not get much use out of a discussion forum. If there is interest in having this, I can set it up. Otherwise, we should probably be able to take care of most discussion during class time and student hours.

2. *WeBWorK.*

   In our WeBWorK online homework system, there is an "Email Instructor" button you can click to send feedback. This is useful if you think there's an error in the question, or if you've tried it several times and can't figure out why you're wrong. That email comes with a link I can use to jump directly to your version of the question, and see what answers you've tried.

3. *Email.*

   You can email me for questions that aren't related to course content. For example, if you have to miss class, or a test, you can email me to let me know.

4 Course policies (an FAQ)

This section deals with questions about accommodations, missed tests, and other exceptional (yet common) cases.

1. *This week is super busy and I don't think I can finish the homework on time. Can I have an extension?*

   Yes. There's a form for that, provided on Moodle. I don't need to know why you need the extension; just what you want extended, when you want it extended to, and whether you need anything from me to help complete the work.

2. *I'm really not comfortable with this whole team thing. What can I do?*

   The team-based discussions are a learning tool, with a lot of very good evidence to support their effectiveness. But they are an alternative to lecture, and not part of the assessment. If you can learn better by working on your own, you can. You might find that the classes are not as useful to you, but the textbook is a great resource, and you can always meet during office hours to ask questions one-on-one.

3. *What happens if I get sick?*

   I'll do my best to be accommodating of any illness that interrupts your studies. There is no need to provide details of the illness. If you miss a week or more of work, please get in touch to make a plan for catching up. One of the biggest challenges in math is that once you fall behind, it's difficult to catch up on your own.

   If you're staying home to avoid spreading illness to others (thank you!), but well enough to attend class, I'll try to provide you with a video link via Teams or Zoom.

4. *What exactly does academic honesty mean?*

   In short, that any work you represent as your own, is your own. Much of your work can be done in groups, but not all of it. I will assume that you have access to a calculator, including online tools (like Symbolab[1]) that give you step-by-step solutions.

   Use of these tools is acceptable, but take care that you are not overly reliant on them. What is not acceptable is having someone else do your work for you. This includes tutors, classmates, friends, family members, and online "homework help" sites. If you submit work that somebody else did for you, you are committing an academic offence.

   Penalties for academic dishonesty are outlined in the Academic Calendar[2]. Depending on the severity of the offence, penalties for a first offence can range from a grade of zero on an assessment, to an F in the courses. Academic offences are also reported to the Dean of Arts & Sciences. They keep a record of each offence, and students with multiple offences can be subject to supplementary discipline.

5. *Does that mean I'm not allowed to get help with my homework?*

   Not at all! But keep in mind that your course instructors will be available for help, free of charge. (OK, maybe not free of charge, but you've already paid for it with your tuition.) We will be responding on the discussion forum regularly, There will be time to ask questions in every class, and there will be online office hours. The Student Success Centre will also be running free help sessions (details TBA).

   Some of you may still decide to pay for tutoring, and that's fine. But you have a duty to disclose sources of help on an assignment, and the individual tests are still tests, even if you won't have someone watching over your shoulder.

   You should probably avoid the various paid "homework help" websites. Most of these don't offer help. They offer worked solutions for a price. Getting those solutions won't help with your understanding. More importantly, the people working for these sites are paid (poorly) per solution, and they often provide incorrect and/or badly written work. (We saw plenty of examples of this last Spring, and yes, all those students now have discipline reports on file.)

[1] `www.symbolab.com/`

[2] `www.uleth.ca/policy/resources/student-discipline-policy-academic-offences-undergraduate-students`

6. *What do I do if I can't write a test during the scheduled time?*

   If you know in advance that you will not be able to write during the test window, let me know, and I'll arrange for an alternate time. If you miss a test due to illness, your test score will be replaced by your exam grade, or the average of your other three tests, whichever is higher.

7. *What if I miss the final exam?*

   If you are unable to write the final exam, you will need to contact Academic Advising. They are responsible for authorizing rescheduling of exams. Usually if you miss an exam due to illness, an incomplete grade is recorded. You will write a makeup exam at a later date, at which point your grade will be updated.

8. *Do I need a doctor's note?*

   No. This wastes health care resources and your time. Just email me to say you were sick, and spare me the details. However, if you miss more than one test due to illness, we'll need to meet to discuss how to adjust your grade.

9. *I receive learning accommodations. What arrangements can I make?*

   First, make sure that you have registered with the University's Accommodated Learning Centre[3]. No need to let me know: they notify me of every student with accommodations.

   Some accommodations will look a bit different this year, but exam accommodations such as extra time are still possible.

   If there are any adjustments I can make to facilitate your learning, please do not hesitate to get in touch with me. All students deserve an equal opportunity to learn. Note that the HTML textbook is designed with accessibility in mind, and should work with screen readers. However, I regret that we have not had the time (or paid help) necessary to add elements such as alt-text descriptions for images. It's on the to-do list, but that list is long, and growing.

10. *Life intervened and I can't keep up this week. What do I do?*

    Send me an email. Extensions are usually granted as long as they're granted ahead of time. Online homework extensions need to be in place before solutions become available. Book an appointment with me as soon as you feel like you're falling behind and I'll do my best to get you up to speed.

5 Learning outcomes for Math 2575

This page outlines the list of competencies each student is expected to achieve in Math 2575. The number following each outcome below indicates the corresponding textbook section. The online homework, tutorial assignments, and tests are all designed to help you achieve these outcomes.

By the end of the course, you should be able to:

A. General skills

   1) Communicate mathematical results clearly and effectively
   2) Use software to assist with computational aspects of the course

B. Chapter 12: Vectors

   1) Use dot and cross products to compare vectors and construct vectors such as projections and normal vectors

[3] `www.uleth.ca/ross/accommodated-learning-centre`

2) Use vectors to describe equations of lines and planes

C. Chapter 13: Vector-Valued Functions

1) Understand the relationship between the formula for a vector-valued function and its graph (13.1)
2) Apply the algebra of vectors to vector-valued functions (13.1)
3) Apply concepts of calculus (limit, derivative, antiderivative) to vector-valued functions (13.2)
4) Understand the significance of the derivative of a vector-valued function in terms of tangents (13.2)
5) Use vector-valued functions to describe motion (velocity, acceleration, etc.) (13.3)
6) Compute the unit tangent and normal vectors and understand their significance (13.4)
7) Compute the curvature of a vector-valued function (13.5)

D. Chapter 14: Differential Calculus in Several Variables

1) Explain what it means for a function of several variables to be differentiable (14.1)
2) Compute and apply the total differential of a function of several variables (14.1)
3) Understand and apply the chain rule for functions of several variables (14.2)
4) Describe the chain rule in terms of matrix multiplication (14.6)
5) Understand the significance of the gradient vector (14.3)
6) Compute the directional derivative of a function of several variables (14.3)
7) Determine the equation of the tangent plane to a surface in three dimensions (14.4)
8) Find and classify critical points for functions of two variables (14.5)
9) Determine the absolute maximum and minimum values of a function subject to a constraint (14.5, 14.7)

E. Chapter 15: Integral Calculus in Several Variables

1) Understand the definition and properties of a double integral (15.1, 15.2)
2) Evaluate a double integral by writing it as an iterated integral (15.1)
3) Change the order of integration in a double integral (15.1, 15.2)
4) Evaluate a double integral using polar coordinates (15.3)
5) Use double integrals to compute centre of mass and moments of inertia (15.4)
6) Set up and evaluate a triple integral in rectangular coordinates (15.6)
7) Use cylindrical and spherical coordinates to evaluate a triple integral (15.7)
8) Use a general change of variables to evaluate a double or triple integral (15.8)
9) Determine the best method (or coordinate system) to solve a double or triple integral

F. Chapter 16: Vector Calculus

1) Set up and evaluate line integrals of scalar and vector fields (15.1, 15.3)
2) Compute the divergence and curl of a vector field, and interpret their meaning (15.2)
3) Determine if a vector field is conservative, and if so, find a potential function (15.3)

4) Understand and apply the Fundamental Theorem of Calculus for line integrals (15.3)
5) Understand and apply Green's Theorem (15.4)
6) Describe a surface in space using parametric equations (15.5)
7) Compute the surface area of a parametric surface (15.5)
8) Set up and evaluate the integral of a vector field over a surface (15.6)
9) Understand and apply Stokes' Theorem (15.7)
10) Understand and apply the Divergence Theorem (15.7)
11) Compare and contrast the different integral theorems, and the relationships between them

6 Course schedule

We will follow the schedule below as closely as possible. Some variations will inevitably occur. In-class problems will be chosen from the indicated sections.

Table 6.1 Schedule for Fall 2023

Monday	Wednesday	Tutorial
	Sept. 6: Syllabus, overview.	Review of vectors.
Sept. 11: RAP 1	Sept. 12: 13.1 and 13.2	Vector-valued functions
Sept. 18: 13.3	Sept. 20: 13.4	Motion, unit tangent and normal vectors
Sept. 25: 13.5	Sept. 27: Ch. 13 wrap-up	No tutorial
Oct. 2: RAP 2	Oct. 4: 14.1	Tangent planes and linear approximation
Oct. 9: Thanksgiving	Oct. 11: 14.2	Chain rule
Oct. 16: 14.3 and 14.4	Oct. 18: 14.5	Integration review
Oct. 23: RAP 3	Oct. 25: 15.1 and 15.2	Double integrals
Oct. 30: 15.3	Nov. 1: 15.6	Applications of integrals (see 15.4)
Nov. 6: 15.7	Nov. 8: 15.8	Triple integrals
Nov. 20: RAP 4	Nov. 22: 16.1 and 16.2	Divergence, gradient, and curl
Nov. 27: 16.3	Nov. 29: 16.4	Line integrals
Dec. 4: 16.5 and 16.6	Dec. 6: 16.7	No tutorial