This syllabus is perhaps much longer than usual due to the unusual circumstances of this semester. I do recommend reading through so that you understand the nature of the course you are taking, and how your work will be assessed. Most of the syllabus concerns boring technical details. Please don’t let that put a damper on your excitement for learning a beautiful topic – the rigorous development of multi-variable calculus.

**Syllabus subject to change:** This syllabus is meant to serve as an outline and guide for our course. Please note that I may make major changes without notice on or before August 10, and, thereafter, I may modify it with reasonable notice to you (and hopefully only minor changes). I may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas.

**INSTRUCTOR DETAILS**

**Instructor:** William Feldman (he/him/his)

**Office:** JWB 101

**Office Phone:** (801) 581-4279 (better use email or Zoom)

**Email:** feldman@math.utah.edu

**Webpage:** math.utah.edu/~feldman

**Zoom handle:** lms-utah.zoom.us/my/wfeldman

**Accessibility and Support:** Generally speaking I will be available for non-private discussions for about 10 minutes after class time. You can also email me anytime, I will respond as promptly as I can, but generally expect to receive a response during “business hours”. You can also set up a time to meet with me on Zoom. I will hold regular
office hours via Zoom the meeting time and location will be announced after a poll of student availability is conducted.

COURSE DETAILS

Course type: IVC (Interactive Video Conferencing)

Class time: MTWF 9:40AM-10:30AM

Location: Zoom Meeting Room : 962 0562 3461 (Password will be available on the Canvas site)

Attendance and Punctuality: Virtual attendance is strongly encouraged but not required. Generally speaking you should have your webcam turned on during class time to help facilitate a more in-person-like classroom experience for all of us. Quizzes and exams will be held synchronously during certain class times, if you are not (virtually) present you will not be able to complete the examination. Policies on make-up quizzes/tests are discussed later in the syllabus.

COURSE MATERIALS

The textbook will not be required for the homework, but my lectures will be based on the textbook (mostly) so it will be useful to have it to follow along.

Textbook: Foundations of Analysis, Joseph L. Taylor

Additional course materials will be shared online via CANVAS.

LEARNING OUTCOMES

The main goal of this course is to provide students with a rigorous approach to the theory of several variables calculus. This is the second course of the MATH 3210–3220 sequence of Foundations of Analysis, a sequence designed to develop the mathematical sophistication of students, while giving them a much deeper understanding of calculus and its foundations than can be provided in the standard courses (MATH 1210, 1220, and 2210). The emphasis is on improving the students’ ability to understand and explain concepts in a logical and complete manner and refine their skill at proofs and mathematical arguments. Students who finish both semesters of the sequence should have the mathematical knowledge and sophistication necessary to do well in 4000 and 5000 level mathematics courses.
COURSE DESCRIPTION

The course will start with the topology of metric spaces and, in particular, multi-dimensional Euclidean spaces: open and closed sets, compactness and connectedness. One of the main theorems we will prove here is the Heine-Borel Theorem characterizing compact sets of finite dimensional Euclidean space. We will generalize our definitions of convergence and continuity using the topological / metric space framework. Then the course proceeds to study Calculus in several variables. First we study differentiation and Taylor’s Formula, proving the extremely important Inverse Function and Implicit Function Theorem (which are basically the fundamental theoretical way of finding solutions to nonlinear systems of equations). Next we continue to the study of integration proving/studying Fubini’s Theorem, the change-of-variables formula, parametrization of and integration on curves and surfaces, computation of tangent spaces and curve/surface length/area. Finally (if time permits) we will arrive at Stokes’s theorem, the fundamental theorem of calculus for curve, surface, and volume integrals.

TECHNICAL REQUIREMENTS

- Students are expected to be computer literate and CANVAS and Zoom navigation skills are expected. Knowledge and navigation of Canvas and Zoom is critical to access all features and resources of this course. Here are some resources on how to use these tools:
  - Canvas Student Guide - https://community.canvaslms.com/docs/DOC-10701
  - University of Utah Teaching and Learning Technologies - https://tlt.utah.edu/
  - Knowledge Commons - https://lib.utah.edu/services/knowledge-commons/

- Ideally you will attend class via a laptop or desktop computer with a camera and a strong internet connection (not cell service based). If you have any problems accessing this technology please let me know, the Mathematics Department and the University will try to help.

Scanning Technology - Homework and Quizzes/Tests may be hand-written. Students must be able to promptly (especially in the case of examinations) scan and submit a PDF copy of their work to Canvas. This can be done using a phone camera and freely available apps. See the following resources:
– Guide on scanning to PDF with phone
– Dropbox (iPhone and Android), Microsoft Office Lens (iPhone and Android), Notes (iPhone)

• During examinations students will be required to be on a Zoom meeting with webcam activated. This will require a device with the capability to use Zoom, a working webcam, and reliable internet connection.

IMPORTANT DATES

Exams: The final exam will be on Friday December 11 from 8-10am. There will be many short quizzes and half-hour tests which are listed in the “Schedule” section below.

Official Drop/Withdraw Dates: The last day to add/drop classes is Friday, September 4; the last day to withdraw from this class is Friday, October 16. Please check the academic calendar for more information pertaining to dropping and withdrawing from a course. Withdrawing from a course and other matters of registration are the student’s responsibility.

Holidays: There will be no class on Monday, September 7 (Labor Day) and November 26-29 (Thanksgiving break).

COURSE DESIGN

This course will use instructor driven online lectures that will be delivered via Zoom video conferencing on canvas during class days and times. All assessments (quizzes and exams) for this course will also be held during class time via Canvas and Zoom.

I hope to make the course as interactive as possible. My impression going in is that the IVC course setting allows for almost as good contact between instructor and student as the in-person setting. The place where IVC is much more difficult is student-to-student interactions. I believe these are extremely important to the undergraduate learning experience, and I will do my best to try to foster those kind of interactions and relationships in this class. To that end I strongly encourage you to unmute yourself during class time to speak up and ask questions, or try to address classmates questions (if you like). Especially in office hours (which I encourage you to attend), but also in class time, we will use Zoom break out rooms to discuss proofs or problems. Any suggestions which you may have for me to help facilitate more interactions are appreciated.
GRADING POLICY

• Calculation of final grade:

  – 20% - Homework - You will be assigned weekly homework assignments on Mondays, due the following Monday. You may discuss the problems with others, but the final write-up should be all in your own words. The lowest three homework grades will be dropped.

  – 20% - Quizzes - There will be 10-15 min quizzes at the beginning of class on Mondays. The quizzes will be open book and open internet (as long as you are not actively communicating with another person). These will focus (but not exclusively) on the material of the homework assignment that was just submitted. Of twelve total quizzes the lowest four scores will be dropped.

  – 30% - Tests (or, really, Big Quizzes) - There will be 20-25 min tests at the beginning of class every other Wednesday. The tests will be open book and open internet (as long as you are not actively communicating with another person). Of seven total tests the lowest two test scores will be dropped.

  – 30% - Final Exam - The final exam period is Friday December 11, 8-10AM. The final exam will be open book and open internet (as long as you are not actively communicating with another person). The exam will be split into multiple timed segments to dis-incentivize cheating. The precise format will be announced, at the latest, a week prior to the exam.

• Your final letter grade will be determined by the following rubric:

  – A : 93%+
  – A- : 86%-92%
  – B+ : 82%-85%
  – B : 77% - 81%
  – B- : 73%-76%
  – C+ : 68% - 72%
  – C : 60%-67%
  – C- : 55%-59%
  – D : 45%-55%
• It is the student’s responsibility to ensure the accuracy of all recorded homework, quizzes, online assignments, and exam grades. Also you should keep as record all your graded assignments. If you see any error in your grades on Canvas, reach out to the instructor as soon as possible, or at the latest within two weeks from when the assignment was returned.

HOMEWORK

Homeworks will be assigned on Monday and due the following Monday. Homeworks will be posted on Canvas and should be submitted on Canvas. See the technical requirements section for instructions on how to submit assignments.

I encourage you to work together in groups on the problems. This does not extend however to the precise wording of your solution write-ups. Your final write-ups should be done independently and in your own words.

Copying another students written solution, even with cosmetic changes, is not acceptable and will be dealt with as an issue of academic integrity (see the section on academic integrity below). Similarly providing your written solution to another student for the purpose of copying is also an issue of academic integrity. Copying a solution found online or requesting a solution by an outside source (like Chegg or TutorMe) is not acceptable and will be dealt with as an issue of academic integrity.

If you have any concerns about the nature of your collaborations please feel free to discuss with me. The best practice is to cite any collaborations with fellow students or any online sources you used in a solution.

LATE ASSIGNMENTS/MISSED ASSIGNMENTS/REGRADING POLICIES

• Homework assignments will not be considered late until 5pm on the day they are due. Generally speaking homework turned in later than that will not be accepted. Recall from above that the three lowest homework grades will be dropped, this already allows some forgiveness for late homeworks. Nonetheless, well documented special circumstances may be considered (e.g. illness). If you need to ask to turn in a homework late you should notify me (by 5pm on the original due date) the reason for the delay and the time you propose to turn in the homework. If you fail to notify me on time the late homework
will not be accepted (again, excepting well documented special circumstances that prevent you from contacting me) and if you miss the new deadline the homework will not be accepted.

- Missed quizzes and tests cannot be made up (except for well documented special circumstances). Instead the lowest four quiz grades will be dropped.

- Regrades: If you notice a mistake in grading you can return your assignment/quiz/test to me to be regraded. You should submit the assignment in question along with a note explaining where you believe the grading error was. The regrade request must be submitted within 1 week of the day you received the graded assignment (barring documented special circumstances). Be warned: when you submit a regrade request the problem in question will be regraded – the score may go up or it may go down. (I don’t mean to sound too ominous I have only very rarely decreased a score on regrade)

**EXAM POLICY**

The online nature of the course presents new challenges for all of us in the delivery, taking, and submission of timed exams. I understand that this is new territory for you as students, and it is new for me as an instructor as well.

Examinations will be time sensitive and held via Zoom during class times. You will be required to download the exam at the beginning of the time period and re-upload your solutions at the end of the time period. I will try to provide sufficient time for downloading and uploading. On Wednesday of the first week we will have a practice quiz where we will try to learn this system together and work out any kinks. The practice quiz will cover review material from 3210 and will not be graded.

All examinations (quizzes, tests, final exam) will be open book and open internet – as long as you are not actively communicating with another person or accessing a problem solution at a “walled” source. In particular you are not allowed to consult with other students during the exam time, and you are not allowed to make use of any online tutoring or answer site like Chegg or TutorMe. These sites will be actively monitored for the posting of exam and quiz questions, and they are actively cooperating with our university to investigate cases of potential fraud and abuse. **Violations of these rules can lead to disciplinary procedures from the Dean of Students.**
SCHEDULE

The pace at which the topics are covered in reality will not necessarily match this idealized schedule. The dates of quizzes, tests and final exam are intended to be fixed. Recall that quizzes take place on Mondays, and tests take place on Wednesdays. There is no Fall Break this year due to the academic calendar alterations made in response to COVID by the university.

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture topics</th>
<th>Quiz</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1 (Aug 24-29)</td>
<td>7.1-7.3 Metric spaces, Euclidean space, convergence, open and closed sets</td>
<td>Prac</td>
<td>No</td>
</tr>
<tr>
<td>Week 2 (Aug 31-Sep 4)</td>
<td>7.4-7.5 Compactness and connectedness</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Week 3 (Sep 7-11)</td>
<td>8.1-8.3 Continuous functions of several variables</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Week 4 (Sep 14-18)</td>
<td>8.4-8.5 Linear algebra and associated geometry</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Week 5 (Sep 17-25)</td>
<td>9.1-9.4 Differentiation in several variables</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Week 6 (Sep 28 - Oct 2)</td>
<td>9.5 - 9.6 Taylor's formula, inverse function theorem</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Week 7 (Oct 5 - 9)</td>
<td>9.6-9.7 Inverse and implicit function theorems (ctd)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Week 8 (Oct 12-16)</td>
<td>10.1-10.2 Integrations over rectangles, Jordan regions</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Week 9 (Oct 19-23)</td>
<td>10.3-10.4 Integration of Jordan Regions, Fubini’s Theorem</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Week 10 (Oct 26-30)</td>
<td>10.5 Change of Variables, 11.1 1-forms and path integrals</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Week 11 (Nov 2-6)</td>
<td>11.2-11.3 Change of variables, higher order differential forms.</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Week 12 (Nov 9-13)</td>
<td>11.4 Green’s Theorem</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Week 13 (Nov 16-20)</td>
<td>11.5 Surface integrals</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Week 14 (Nov 23-27)</td>
<td>11.5 Stokes’ Theorem</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Week 15 (Nov 30 - Dec 4)</td>
<td>(F is reading day)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Week 16 (Dec 7 - Dec 11)</td>
<td>Final Exam: Friday December 11, 8-10AM</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
COVID related details

Due to the online nature of the course, we should be mostly unaffected by COVID related developments (e.g. classes going online, possible stay-at-home orders). Nonetheless I understand that there may be unforeseen additional burdens which affect each student differently. Please keep me informed about any COVID related situations which may affect your work in the course, I will work with you individually to come up with solutions.

General university policies, resources, and advice

ACADEMIC INTEGRITY

Students are encouraged to review the Student Code for the University of Utah: https://regulations.utah.edu/academics/6-400.php. In order to ensure that the highest standards of academic conduct are promoted and supported at the University, students must adhere to generally accepted standards of academic honesty, including but not limited to refraining from cheating, plagiarizing, research misconduct, misrepresenting one’s work, and/or inappropriately collaborating. A student who engages in academic misconduct as defined in Part I.B. may be subject to academic sanctions including but not limited to a grade reduction, failing grade, probation, suspension or dismissal from the program or the University, or revocation of the student’s degree or certificate. Sanctions may also include community service, a written reprimand, and/or a written statement of misconduct that can be put into an appropriate record maintained for purposes of the profession or discipline for which the student is preparing.

INCOMPLETES

According to university policy, to be considered for an incomplete, a student must have 20% or less of the course work remaining and be passing the course with a C or better. You must request an incomplete grade and I will consider giving that grade only under exceptional circumstances.

NETIQUETTE

- Classroom equivalency: Respectful participation in all aspects of the course will make our time together productive and engaging. Zoom lectures, discussion threads, emails and canvas are all considered equivalent to classrooms and student behavior within those environments shall conform to the student code. Specifically:
– Posting photos or comments that would be off-topic in a classroom are still off-topic in an online posting.
– Disrespectful language and photos are never appropriate.
– Using angry or abusive language is not acceptable, and will be dealt with according to the Student Code. The instructor may remove online postings that are inappropriate.
– Do not use ALL CAPS, except for titles, or overuse certain punctuation marks such as exclamation points and question marks.
– Course e-mails, e-journals, and other online course communications are part of the classroom and as such, are University property and subject to the Student Code. Privacy regarding these communications between correspondents must not be assumed and should be mutually agreed upon in advance, in writing.

• Other expectations for online communication (on Discussion Board, Emails, Zoom chat etc):

  – Emails: When emailing your Instructor and Teaching Team keep a professional tone. Use a descriptive subject line, avoid “Hey” and always use your professors’ proper title: Dr. or Prof., sign your message with your name and return e-mail address. Please consult this page for tips on how to write appropriate professional emails:
    https://academicpositions.com/career-advice/how-to-email-a-professor
  – Treat your instructor, teaching team and classmates with respect in email or any other communication.
  – Remember that all college level communication should have correct spelling and grammar (this includes discussion boards).
  – Avoid slang terms such as “wassup?” and texting abbreviations such as “u” instead of “you.”
  – Be cautious when using humor or sarcasm as tone is sometimes lost in an email or discussion post and your message might be taken seriously or be offensive to others.
  – Be careful with personal information (both yours and others).

**ADDITIONAL POLICIES AND RESOURCES**
• Inclusivity Statement. It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: age, color, disability, gender, gender identity, gender expression, national origin, political affiliation, race, religion, sexual orientation, and veteran status, and other unique identities. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

• Discrimination and Harassment. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or Office of the Dean of Students, 270 Union Building, 801-581-7066. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS). Please see Student Bill of Rights, section E http://regulations.utah.edu/academics/6-400.php. I will listen and believe you if someone is threatening you.

• Names/Pronouns. Canvas allows students to change the name that is displayed AND allows them to add their pronouns to their Canvas name. Class rosters are provided to the instructor with the student’s legal name as well as “Preferred first name” (if previously entered by you in the Student Profile section of your CIS account, which managed can be managed at any time). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class or on assignments. Please advise me of any name or pronoun changes so I can help create a learning environment in which you, your name, and your pronoun are respected. If you need any assistance or support, please reach out to the LGBT Resource Center. https://lgbt.utah.edu/campus/faculty_resources.php

• English Language Learners: If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include:
the Writing Center (http://writingcenter.utah.edu/); the Writing Program (http://writing-program.utah.edu/); the English Language Institute (http://continue.utah.edu/eli/). Please let me know if there is any additional support you would like to discuss for this class.

- **Undocumented Student Support.** Immigration is a complex phenomenon with broad impact – those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu.

- **Veterans Center.** If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: http://veteranscenter.utah.edu/. Please also let me know if you need any additional support in this class for any reason.

- **Wellness Statement.** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

- **Student Success Advocates.** The mission of Student Success Advocates is to support students in making the most of their University of Utah experience (ssa.utah.edu). They can assist with mentoring, resources, etc. Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact a Student Success Advocate for support (https://asuu.utah.edu/displaced-students).

- **The Americans with Disabilities Act.** The University of Utah seeks to provide equal access to its programs, services and activities for
people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

- **Addressing Sexual Misconduct.** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran¹’s status or genetic information. If you or someone you know has been harassed or assaulted on the basis of your sex, including sexual orientation or gender identity/expression, you are encouraged to report it to the University’s Title IX Coordinator; Director, Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or to the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to police, contact the Department of Public Safety, 801-585-2677(COPS).

- **Campus Safety.** The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

- **University Counseling Center.** The University Counseling Center (UCC) provides developmental, preventive, and therapeutic services and programs that promote the intellectual, emotional, cultural, and social development of University of Utah students. They advocate a philosophy of acceptance, compassion, and support for those they serve, as well as for each other. They aspire to respect cultural, individual and role differences as they continually work toward creating a safe and affirming climate for individuals of all ages, cultures, ethnicities, genders, gender identities, languages, mental and physical abilities,
national origins, races, religions, sexual orientations, sizes and socioeconomic statuses.

- **Office of the Dean of Students.** The Office of the Dean of Students is dedicated to being a resource to students through support, advocacy, involvement, and accountability. It serves as a support for students facing challenges to their success as students, and assists with the interpretation of University policy and regulations. Please consider reaching out to the Office of Dean of Students for any questions, issues and concerns. 200 South Central Campus Dr., Suite 270. Monday-Friday 8 am-5 pm.