

Syllabus for Math 370: Calculus on Manifolds

Morgan Weiler, Rice University, Fall 2020

Time: TTh 9:40-11:00 Central. No class Thursday 10/1 and Tuesday 11/3.

Room: Canvas. Zoom, Gradescope, and YouTube info on Canvas. Course website: <https://math.rice.edu/~mw79/f20math370.html>

Office Hours: Wednesdays 11-12 Central and by appointment (see below).

Text: Fortney, *A Visual Introduction to Differential Forms and Calculus on Manifolds*. Optional: Munkres, *Analysis on Manifolds*.

TA: Leo Digiosia.

Prerequisites: Math 302/321/331 and Math 354/355

Final Exam: Take home

Outline of topics: Our goal is to understand differentiation and integration on spaces more complex than those studied in multivariable calculus, and with greater mathematical precision.

- Differentiation of multivariable functions: the Jacobian, the multivariable chain rule, the inverse and implicit function theorems, differential forms.
- Manipulation of differential forms: wedge product, exterior differentiation, change of variables, integration of differential forms.
- Basic theory of manifolds.
- Closed and exact forms: Poincaré lemma, Stokes' theorem.

Assessment: Your grade will be the maximum of either

$30\%(\text{hw}) + 10\%(\text{weekly questions and participation}) + 5\%(\text{quizzes}) + 20\%(\text{midterm}) + 35\%(\text{final})$

$30\%(\text{hw}) + 10\%(\text{weekly questions and participation}) + 5\%(\text{quizzes}) + 25\%(\text{midterm}) + 30\%(\text{final})$

I will not accept late assignments, but I will drop your lowest two homework, weekly quiz, and weekly question scores.

Class format: This class will be taught online. This gives us an opportunity to make some interesting changes!

Online resources: Canvas will be our main online resource, where I will notify you of assignments and which we will use for out-of-class discussions. We will use Gradescope for homework. I will post my short videos to YouTube, but will only post recordings of class periods to Canvas.

Contacting me: Use Canvas messages to contact me about the course instead of email. If your question would be interesting to the whole class, please use a public Canvas Discussion, and if it is confidential, please use a private Canvas message.

Videos and reading: On or before each Tuesday I will post the next week's reading, videos, and quiz to Canvas. I will also post the videos to YouTube. You should have watched all posted videos, read all required reading,¹ taken the weekly quiz, and submitted your question for the week by the beginning of class on the following Tuesday.

Weekly quiz: The weekly quiz will be short and is intended to help you review the videos you have watched. It is not intended to be difficult, but to be diagnostic: if you do not get a high score, go back and review the videos and reading. You will be able to retake the quiz once.

Weekly questions vs. Canvas Discussions/Messages: Before the beginning of class each Tuesday, you will be required to submit at least one substantive question for me about the week's material to Canvas (as an Assignment). These questions should be about the theory we are learning, whereas Canvas Discussions should be used primarily for discussion with your fellow students and difficulties with examples and homework problems, or for questions about material from past weeks. As your guide, consider: do you want the question to be answered by me in real time, during a class period? If so, submit it as your weekly question. If it is something for which a text response will do or you think your peers could help you with, or concerns material from previous weeks, post it on Canvas under Discussions.

Class time: On Tuesdays we will fill in details of topics introduced in the videos and reading and address student questions. On Thursdays we will discuss the homework and do group work. I will post the videos of classes and my notes to Canvas after each class.

Participation: Due to time zone differences, *attendance is not required*. Your participation grade will be based on your submission of weekly questions and participation in the Canvas Discussions. It does not matter whether you are asking vs. answering questions, just that you are posting regularly (e.g. every couple of weeks).

Office Hours: My scheduled office hours will be Wednesdays 11-12 Central. Because we may be in different time zones, I am not going to schedule more office hours. Instead we will use an appointment system. If you cannot make the Monday office hours, please message me on Canvas to schedule a meeting some other time during the week. If you would like our meeting to be private please let me know, otherwise I may overlap students (since you may have similar questions for office hours).

Why are we doing all this? I hope to avoid long lectures over Zoom, thus the multiple short videos per week. I also want to be responsive to your understanding of the material, hence the weekly quizzes and weekly questions, which are intended to be helpful and not difficult. I hope you are spending only half an hour per week in total on these quizzes and questions.

Exams: There will be a take-home midterm and final, which will both be pledged. The midterm will be published after class on Tuesday, 9/29, and due at the end of class time on Thursday, 10/1, on Gradescope. Class will be cancelled Thursday, 10/1, and there will be no homework due 10/1. Details of the final will be forthcoming. Both the midterm and final will be open book for all course materials (book, notes, prerecorded videos, videos of lectures), but you will not be allowed to post to Canvas during the midterm and final exam periods, you should not ask me or Leo for help beyond questions clarifying the wording of the exam, and you will not be allowed to "actively" use the internet for the exam, e.g. you should not post the exam questions online or discuss the particulars of the exam with anyone.

¹You will not be required to read the whole textbook. However, if you are confused, the textbook should be the first place you look for additional details.

Homework: I will assign 5-10 problems weekly. They will be due Thursdays before class, starting 9/3. You are encouraged to work together and to come to office hours to discuss homework problems with me and Leo, however, you each need to write up your own solutions alone. You will submit homework on Gradescope.

You will also be responsible for completing the weekly quiz and submitting your question to Canvas by the beginning of class on Tuesday.

This schedule will be changed during the weeks around the midterm, the week of election day 11/3, and including and after Thanksgiving week; details forthcoming.

Accommodations: If you require accommodations due to a disability, please let me know *at least two weeks in advance* of the part of the course for which you will require an accommodation. Please also make sure this documentation is on file with Disability Resource Center (Allen Center, Room 111/adarice@rice.edu/x5841) to determine the accommodations you need.

If you have a conflict with the exam dates, please let me know *at least two weeks in advance*.

This semester may present unique challenges to all of us due to COVID-19. Please let me know if there are any unexpected or unusual difficulties which significantly impact your ability to engage with the course.

Statement on collegiality, respect, and sensitivity: The Dept of Mathematics supports an inclusive learning environment where diversity and individual differences are understood, respected, and recognized as a source of strength. Racism, discrimination, harassment, and bullying will not be tolerated. We expect all participants in mathematics courses (students and faculty alike) to treat each other with courtesy and respect, and to adhere to the mathematics department standards of collegiality, respect, and sensitivity

math.rice.edu/department-statement-collegiality-respect-and-sensitivity

as well as the Rice Student Code of Conduct. If you think you have experienced or witnessed unprofessional or antagonistic behavior, then the matter should be brought to the attention of the instructor and/or department chair. The Ombudsperson is also available as an intermediate, informal option, and contacting them will not necessarily trigger a formal inquiry.

Title IX statement: Title IX Responsible Employee Notification

Rice University cares about your wellbeing and safety. Rice encourages any student who has experienced an incident of harassment, pregnancy discrimination or gender discrimination or relationship, sexual, or other forms interpersonal violence to seek support through the SAFE Office. Students should be aware when seeking support on campus that most employees, including myself, as the instructor, are required by Title IX to disclose all incidents of non-consensual interpersonal behaviors to Title IX professionals on campus who can act to support that student and meet their needs. For more information, please visit safe.rice.edu or email titleixsupport@rice.edu.

This syllabus is subject to change at any time. I will do my best to inform students of all such changes as quickly as possible.