Math 106L: Laboratory Calculus and Functions 2 (Fall 2022)

Lecture: MWF 12:00 to 12:50 PM (West Duke 08A)
Lab: TTh 12:00 to 12:50 PM (West Duke 08A)

Your instructor

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Office hours: On Zoom, link here and times to be determined
About me: My name is Kyrie, my pronouns are they/she, and I am a graduate student in the Duke math department. I prefer to be addressed by 'Kyrie', but 'Instructor' or 'Instructor Johnson' are also fine. Learning calculus was what finally sold me on the utility and beauty of mathematics, so I'm excited to share that with y'all in 106L! Outside of math, I enjoy rock climbing, reading, sewing, playing video/board games, and cooking.

What is this course about?

We will begin 106L by concluding 105L's introduction to differential calculus: this includes a review of trigonometry, a study of derivatives of trig functions, and their applications (e.g. to the study of climate). We will then turn to 'anti-differentiation' and develop the theory of integral calculus, which is a sort of opposite to differentiation. We will conclude the course with an extensive module on 'differential equations', including a variety of applications that draw from physics, chemistry, ecology, and economics. Calculus is a powerful tool across the physical and social sciences, and this course will prepare you to use it in whatever discipline(s) you pursue.

What background knowledge do I need before taking this course?

The only prerequisite for this course in Math 105L. For a list of key topics from 105L which we will use in this course, look at 'Worksheet 1: Review of 105L Concepts' on the course webpage; although this worksheet will be your first assignment in the course, it is intended as a refresher/review and thus demonstrates the background knowledge you will need.

What will I learn in this course?

Here are some big-idea questions which the content of 106L will answer:

- What is the opposite of differentiation?
- What does the area under a curve represent, and how can we calculate it?
- How can we extract knowledge of a function from an equation involving derivatives?

In precise terms, which might not make sense to you right now but will make sense by the end of the semester: after taking this course you will be able to

- Differentiate trig functions and inverse functions;
- Solve related rates problems involving triangles;
- Anti-differentiate a variety of functions;
- State the definition of an integral, interpret its meaning, and be able to translate relevant word problems into an integral via the theory of Riemann sums;
- State the definition of a differential equation, interpret its meaning, and solve certain differential equations (either exactly or approximately via Euler's method);
- Analyze selected applications of differential equations (especially heating and mixing, growth of a population, and chemical reactions); and
- Succeed in Math 112L or an equivalent course.

What will we do in this course?

MWF Classes: I will have a 'lecture' prepared for each class, which will take some portion of class time. Each class has an accompanying class worksheet, linked from the course schedule on the course webpage; **you must come to each class with that day's worksheet, ready to write on it.** On most class days, I will not spend the entire class lecturing, and y'all will spend the remaining time working on the worksheet either alone or in small groups.

TTh Labs: Each lab will begin with a short introduction by the lab instructor. Then y'all will work in pre-assigned groups of 3-5 on the lab assignment while the lab instructor and lab TA rotate through groups to facilitate group work. Note that group work is a key component of lab, and one of your goals in lab should be to exercise your mathematical collaboration, communication, and creativity. The lab assignments are designed to encourage this: they are longer assignments that either explore ideas from class in greater depth or apply those ideas to data sets.

Visibility Lab: The last week of October and the first week of November will be devoted to a unique lab, which will you complete either as an individual or in a group of your choosing (see the assignment page for details). To demonstrate – by example – some of what I expect from this assignment, each week I will email the class a blurb about a mathematician of my choosing.

Big assignments: There are three big assignments scattered throughout the semester which you will submit individually and have an opportunity to resubmit to earn half-credit back (see grading 'How will my grade be determined?' below). Each big assignment will have a MWF class period devoted to working on that assignment with me available to answer questions.

How can I prepare for the class sessions to be successful?

Because each MWF class has an accompanying class worksheet – linked from the course schedule – you must come to class ready with that day's worksheet in a format you can write on (for example, by printing it out or accessing it on a tablet). For TTh labs, you can prepare by reviewing recent worksheets (whose material you will use/apply in labs) and communicating with your group about any agreed upon out-of-lab work. **Because class-time and lab-time form the backbone of the course, both class and lab attendance are mandatory** (see 'How will my grade be determined?' below). You can prepare yourself to get the most out of class sessions by arriving early; this ensures that you have time to setup the worksheet/lab assignment and review the previous day's material.

What are the required texts and materials?

The course textbook is *Calculus* by Hughes-Hallett et. al., 7th edition. We will not use the textbook directly, as we will use class/lab worksheets which are always available on the course webpage. However, the textbook for the class provides background and supplemental material and you are encouraged to read the relevant section(s) of the textbook, either before or after a given class session depending on your needs and learning style. Moreover, the problems at the end of each chapter are useful to do in addition to the worksheets, and solutions to all textbook problems are available on Sakai under Resources --> Documents --> Solutions Manual. To clarify, no questions from the textbook will be collected or graded; they are but another resource for your learning, and the solutions on Sakai can help you to self-assess your learning.

Note that if you are struggling to access the textbook due to cost, you may contact the financial aid office (whether or not you are on aid) to receive aid or a loan.

What technologies will we use?

The main source for all course materials is the course webpage, linked on my Duke website and on the course Sakai page. We will use Sakai only to house the course website link, to record 'grades' on each assignment, and to access textbook solutions. All assignments will be handed in online (on Gradescope); there is a page on the course website dedicated to the topic of using Gradescope.

Calculators will be useful, so you should be able to access one as a support tool (for example, Desmos online graphing calculator). However, be wary and limit your reliance on a

calculator; for example, you should still know the shapes of graphs of fundamental functions.

You must be able to access MWF class worksheets in class: if you choose to print them, then you must have access to a printer, and if you choose to access them on a tablet, then you must have familiarity with using a tablet.
Likewise, for labs you must have access to: the lab worksheet, a method of contributing to your group's lab report, and Google sheets (for labs involving spreadsheets). This access is most easily achieved via a personal laptop, so if you have one please bring it to lab. If you do not have a laptop, please let me know as soon as possible so that we can discuss ways for you to access lab materials during lab.

For immediate assistance with learning technologies, system errors/outages, or your NetID account and password, contact the OIT Service Desk.

How will my grade be determined?

Grading for this course will take the form of *mastery* grading. That is, you will be graded on whether you have shown in-depth understanding of the material covered *over time*, rather than being asked to reproduce knowledge at one given time (for example, on an exam). Further, 106L is an S/U class so at the end of the course you will either pass (earn an S on your transcript) or not pass (earn a U on your transcript).

General Structure

- You will be given a chance to submit, receive feedback, and redo work on individual and group assignments before they are marked as complete. Once an assignment has been marked complete, you will receive either a pass or a no-pass for it.
- For group assignments, all members of a group will be expected to contribute approximately equally to all assignments; your group will make a single submission on Gradescope, and that submission will apply to all members of the group.
- The three `big assignments' will be graded numerically. You will be able to resubmit them but will receive half-credit for answers that needed redoing if they are correct on resubmission: if you scored 60% on the assignment, then *completely* corrected all of your mistakes, you will receive an overall score of 80%. A passing score on these assignments will be 70%.
- Both class attendance and lab attendance are mandatory. Because labs involve group work, you must actively participate in lab by working with your group and if you are going to miss lab, you must communicate this with your group and coordinate to contribute equally to the lab assignment. If you must miss lab/class due to physical/mental health, an emergency, Duke varsity sports, or another excused reason, you must submit a formal excuse form here.

Assignment Content, Deadlines, and Grading

- For all classes in which a worksheet is used (the vast majority of MWF sessions), your assignment for that class will be completion of the worksheet. You will often have time in class to work on worksheets and receive immediate feedback from me.
- Worksheet assignments will be due the following Sunday at midnight (any exceptions will be announced in class and indicated in Gradescope). However, since each class builds on previous material, it is recommended that you complete the worksheet before the next class.
- Graders and instructors will aim to get new worksheets commented upon and resubmissions graded by the Friday morning after they are submitted. Resubmission deadlines will be the following Monday at midnight.
- For any given assignment, both deadlines must be met in order to receive credit for the assignment. In other words, you must both submit and resubmit each assignment.
- Group projects or assignments will be assigned to some labs (see webpage for details). In general, lab assignments finish on Thursdays and they will be due the following Thursday at midnight.

To summarize, every week, you will submit as an individual:

- **By Sunday at midnight:** A first submission of the previous week's worksheets;
- **By Monday at midnight:** A resubmission of the worksheets you received comments on the prior Friday.

To pass the class (and thus earn an S on your transcript):

- You must accumulate 27 out of 32 passes on individual assignments. You must also pass 3 of the last 4 worksheets and you must pass the last worksheet.
- You must submit all three 'big assignments' and corrections, and achieve passing scores (over 70% after resubmission) on at least 2 of the 3.
- You must meaningfully contribute to all group assignments (in lab) and receive credit for at least 6 of 7 such assignments. You must also pass the last lab.
- You must pass the 'Visibility Lab' (this assignment is not counted in the previous bullet).
- **You must have no more than 3 unexcused absences across classes and labs.** For an absence to count as 'excused', you must submit a formal notification here.

What is the course schedule?

See the course webpage for a full schedule (link here). I recommend that you bookmark this page as you will need it regularly to access course materials.

Course Communication

All class communication will take place by email to your Duke email address, so it is imperative that you check it very

regularly! Likewise, during the week (Monday through Friday), I am accessible by email. On the weekends, I will respond to emails but responses will be less detailed and much less prompt.

If you miss a class for an excused reason, you must communicate this by submitting a formal notification here. If you miss lab (excused or unexcused), you must let your group know *as soon as possible* and coordinate with your group to ensure that you contribute an equal amount of work to the lab assignment. In either case, refer to the course schedule to see what you missed.

Group work guidelines

The mathematician Federico Ardila writes that 'everyone can have joyful, meaningful, and empowering mathematical experiences' and that 'every student deserves to be treated with dignity and respect' (see here). I agree, and I expect our work in 106L – in and out of the classroom – to uphold these values. To succeed in this course, you will have to actively interact with your peers, your instructors, and your TA's, so please adhere to these guidelines:

- Respect that others' opinions, beliefs, perspectives, and experiences may differ from your own.
- If you disagree with an idea (mathematical or non-mathematical) communicated by a fellow student, you may critique the idea, but not the person.
- Listen carefully, be courteous, and don't interrupt.
- Communicate thoughtfully, be patient, and leave space for others.
- Support your statements with evidence and sound reasoning.
- Try to moderate how you contribute to discussions:
    - if you have a lot to say, try to avoid dominating the conversation; and
    - if you are reluctant to speak up, look for ways/opportunities to share your perspective.

Please bring any communications you believe to be in violation of this class policy to my attention.

Diversity and Inclusion

Federico Ardila also affirms that 'mathematics is a powerful, malleable tool that can be shaped and used differently by various communities to serve their needs' and that 'mathematical talent is distributed equally among different groups, irrespective of geographic, demographic, and economic boundaries' (see here). I agree, and I expect that our work in 106L – in and out of the classroom – creates space for everyone to access the incredible tool which we call calculus.

Because group work is a key component of the course, part of how we will cultivate an inclusive culture in our class is by adhering to the above group work guidelines. In addition, I hope that through

- the weekly blurbs I send about various mathematicians, and

- the ‘Visibility Lab’ assignments y’all will prepare,

we will connect a bit of our course material to some of the diversity in the mathematical (and math-adjacent) community.

Getting Help

You will need help with this class! Everyone will. Math is a challenging subject, and this class will ask a lot of you. There is a list of resources on our course webpage (see here).

Academic Accommodations

If you need to request accommodation for a disability, you can contact the Disability Management System (DMS) office. I will work with that office to provide you with equal access to course materials and make accommodations for course assignments. Note that accommodations cannot be provided retroactively, so it is best to contact the DMS office sooner rather than later.

Academic Integrity

As a student, you should abide by Duke’s Community Standard, which states:

“Duke University is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect and accountability. Citizens of this community commit to reflect upon and uphold these principles in all academic and nonacademic endeavors, and to protect and promote a culture of integrity.

To uphold the Duke Community Standard,

- I will not lie, cheat, or steal in my academic endeavors.
- I will conduct myself honorably in all my endeavors; and
- I will act if the Standard is compromised.

It is the responsibility of the student to understand and follow Duke policies regarding academic integrity, including doing one’s own work, following proper citations of sources, and adhering to guidance around group work.”

If you are ever unsure about what constitutes a breach of academic integrity in the context of our course, feel free to talk to me! In general, I will handle academic misconduct on a case-by-case basis; that may mean that a student receives a no-pass on an affected lab/worksheet assignment and/or receives a point penalty on an affected big assignment. Egregious academic

misconduct may necessitate involvement of the Office of Student Conduct.

Policy Change

All policies in this syllabus are subject to reasonable change at my discretion. I will announce any changes in class, and will update this document and the course website (where relevant) to reflect the change.