Clemson University
School of Mathematical & Statistical Sciences

MATH 4340-241 / 6340-241, Advanced Engineering Mathematics
M–F (online, asynchronous), Summer Session II, 2023
Syllabus

Instructor: Prof. Matthew Macauley, Martin O-325, macaule@clemson.edu, 656-1838 (no voicemail)

Course Description: This course is an introduction to Fourier Series and Partial Differential Equations. Throughout the country, these topics are taught in a variety of contexts – from a very theoretical course on PDEs and Applied Analysis for senior math majors, to a more computational course geared torwards engineers, e.g., a "Differential Equations II" class. My goal in this course is to strike a balance between these two extremes. I have included enough basic linear algebra (vector spaces, independence, basis, inner products, self-adjoint operators) so the students can see the mathematical structure behind the scenes. However, I have omitted advanced details such as Hilbert spaces, and different types of norms and convergence (pointwise, uniform, and in norm). My goal is for this to be useful to math, science, and engineering majors alike.

Topics include vector spaces, inner products, orthogonality, linear differential operators, linear ODEs, power series solutions and the method of Frobenius, Bessel's equation, real and complex Fourier series, Fourier sine and cosine series, Fourier transforms, Parseval's and Plancherel's identities, boundary value problems, self-adjoint linear operators, Sturm-Liouville theory, generalized Fourier series, Fourier's law, the heat equation, the wave equation, Schrödinger equation, Cauchy problems, the reflection method for semi-infinite domains, solving PDEs with Laplace and Fourier transforms, harmonic functions, Laplace's equation, PDEs in higher-dimensions, PDEs in polar coordinates.

Prerequisite: Math 2080 (Differential Equations).

Communication Strategy: I generally prefer to communicate via emails rather than Canvas messages.

All of my email addresses (e.g., **macaule@clemson.edu**) go to the same gmail inbox, which I check multiple times on weekdays. I often don't check email on Saturdays. Though I have the gmail app on my phone, I do not get push notifications for emails.

If you send me an email and do not get a reply by the time you go to bed, please re-send it, as that is my mistake. Just click "Reply" and "Send"; no need to explain.

Office Hours: Every weekday evening at 7pm, you are invited to join me and your classmates on Zoom for a (non-alcoholic) Adult Beverage[1], company, and office hours. I'll stick around to answer questions as long as there are some. However, *I will only show up if at least one person RVSPs, by sending me an email before 4pm saying they will attend.* If there has been an RSVP but no one is there by 7:05pm, I will log off.

Useful websites:

Course webpage: `http://www.math.clemson.edu/~macaule/classes/m23_math4340/` (all relevant links posted here)

Gradescope: `https://www.gradescope.com/` (homework will be submitted here)

[1]For me, this means drinks like **LaCroix** or **Kombucha**, which are *very unpopular* among kids.

Texts: The course will not follow one particular textbook, but there are several high-quality freely available books that will be helpful resources. The following are listed in (approximate) increasing order of technical difficulty.

John Douglas Moore. *Introduction to Partial Differential Equations.* Kendall Hunt, 2005.

Peter J. Olver. *Introduction to Partial Differential Equations.* Springer Undergraduate Texts in Mathematics, 2014.

J. David Logan. *Applied Partial Differential Equations.* Springer Undergraduate Texts in Mathematics, 2015.

Marcus Pivato. *Linear Partial Differential Equations and Fourier Theory.* Cambridge University Press, 2010.

The pdfs of Moore, Logan, and Pivato are freely available online. Olver's text can be accessed as an eBook through the Clemson University Library. The links to all of them are on the course webpage.

Zoom Info: There will be one common Zoom URL for all evening office hours, and I will post this on Canvas. I am also available to meet by appointment, if needed. In that case, email me and include block(s) of time in which you are available. Please let me know in advance if you want any meeting to be private, like if you want to discuss your grade. In that case, I will use a different Zoom meeting.

Schedule: This course is being offered in an entirely online and asynchronous format. The course calendar can be found on the course website.

Lectures: There will be 38 lectures, ranging in length from 26 to 56 minutes, that are be available on YouTube. Students will be required to watch 1–2 lectures each day. The lecture schedule is listed on the course calendar.

Course Format: This course is being offered in one summer semester so EVERYTHING GOES QUICKLY. I have taught this class several times during a regular semester and I plan to cover the same amount of material and assign the same amount of homework, but over 5 weeks instead of 15.

You should expect to spend *at least* 3 hours per day on this course:

Watching 1–2 online lectures.

Working homework problems.

You will take two Midterms and a cumulative Final Exam.

Because this is an online course, our chief means of communication is through e-mail. It is important that you check your Clemson e-mail on a regular basis — at least once a day.

Homework: There are 13 homework assignments that are posted on the course webpage. During the regular semester, these would be "weekly." Students will be required to upload and submit each assignment on Gradescope as a single pdf file with multiple pages (*not* one document per page). Students can either handwrite and scan their assignments, or typeset them using LaTeX. Homework assignments are due at 11:59pm. Assignments can be submitted multiple times; only the last submission will be graded. There is a 3-hour grace period for deadlines, meaning that is no penalty for assignments submitted within 3 hours of the deadline. Beyond that, late assignments will NOT be accepted. Any homework typeset in LaTeX gets an automatic 24-hour extension.

Exams: There will be 2 exams (closed book and notes) during the semester and a cumulative final exam: Midterm 1 on Wed. July 12, Midterm 2 on Wed. July 26, and the Final Exam on Fri. August 4. All three exams must be taken either at Clemson or at an approved proctored test facility. Guidelines for administration of these exams are given in the separate write-up under the heading Proctored Tests Policy. These guidelines must be followed by all students.

Grading: Your final grade will be computed as follows:

Homework	25%
Midterm 1	25%
Midterm 2	25%
Cumulative Final Exam	50%

I will drop either your lowest midterm grade, OR half of the weight of the final exam; whichever is lowest. Also, if you get an **A** or **B** on the final exam then you will get at least that grade in the course, *assuming you have a passing grade (50%) on the homework.*

I do *not* necessarily grade using arbitrary round number cut-offs, as sometimes I like to err on the difficult side for exams. That said, 90+ will always be an A, 80+ will always be at least a B, 70+ will always be at least a C, and 60+ will always be at least a D.

The automatically calculated numeric grade that you see in Canvas or Gradescope is NOT an accurate indicator of your grade. At any point in time during the class, I would be happy to give you a ballpark estimate of how you are doing.

Make-Up Policy: No make-up exams will be given. I will drop your lowest midterm, which means that if you miss a midterm, then your final exam grade will replace it. The homework deadlines will not be extended for individual students, and assigned homework must be turned in by the deadline. PLAN AHEAD: If you submit assignments minutes before the deadline, you take the risk of bad luck, e.g., a power outage, computer freeze or crash, personal emergency, zombie attack, etc., that could make you miss the deadline.

Required technology:

A computer on which you can watch the YouTube lecture videos and view pdf files.

A smartphone scanning app. There are many free apps, such as CamScanner or Adobe Scan. If you do not have a smartphone, a traditional scanner will suffice, but a smarphone app is prefered.

A calculator is *not* required nor needed for this course, and will not be allowed on exams.

Student Learning Outcomes: Upon successful completion of MATH 4340, students will be able to

Understand the basic theory of differential operators and linear ordinary differential equations (ODEs) from a high-level perspective. In particular, understand the beautiful linear algebra hiding behind the scenes.

Solve ODEs whose solutions are generalized power series and understand the convergence of these solutions.

Derive the Fourier series expansions of periodic functions, and understand the theory behind the construction in terms of inner product spaces.

Understand boudary value problems of ODEs and solve the corresponding Strum-Louiville equations.

Construct, interpret, and utilize solutions to one-dimensional partial differential equations (PDEs), such as the heat and wave equation. Understand the difference between different boundary and initial conditions.

Solve the standard PDEs (heat, wave, and Laplace's equation) in two-dimensions, both in rectangular and polar coordinates.

Explain in simple terms, e.g. to grandparents or to younger siblings, how ordinary and partial differential equations are relevant to several familiar settings in your major.

Key Dates

June 28 (Wed)	Classes begin; late enrollment fee applies
June 29 (Thu)	Last day to register or add a class
July 3 (Mon)	Last day to drop a class or withdrawfrom the University without a W grade
July 4 (Tue)	Holiday
July 12 (Wed)	Midterm 1
July 21 (Thu)	Last day to drop a class or withdraw from the University without final grades
July 26 (Wed)	Midterm 2
Aug 2 (Wed)	Last day of class
Aug 4 (Fri)	Final Exam

Mental health: Your mental health is important to me, and I am always available to talk. Please don't hesitate to reach out. We're in this together, and all of us are strugling in some regards, myself included.

Academic Integrity: "As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning'. Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form."

Special Accommodations: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know, and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: `http://www.clemson.edu/campus-life/campus-services/sds/`.

Title IX Policy: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against

sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972.

The University is committed to combatting sexual discrimination including sexual harassment and sexual violence. As a result, you should know that University faculty and staff members who work directly with students are required to report any instances of sexual harassment and sexual violence, to the University's Title IX Coordinator. What this means is that as your professor, I am required to report any incidents of sexual harassment, sexual violence or misconduct, stalking, domestic and/or relationship violence that are directly reported to me, or of which I am somehow made aware.

There are two important exceptions to this requirement about which you should be aware:

Confidential Resources and facilitators of sexual awareness programs such as "Take Back the Night and Aspire to be Well" when acting in those capacities, are not required to report incidents of sexual discrimination.

Another important exception to the reporting requirement exists for academic work. Disclosures about sexual harassment, sexual violence, stalking, domestic and/or relationship violence that are shared as part of an academic project, a research project, classroom discussion, or course assignment, are not required to be disclosed to the University's Title IX Coordinator.

This policy is at `http://www.clemson.edu/campus-life/campus-services/access/title-ix/`. Alesia Smith is the Executive Director for Equity Compliance and the Title IX Coordinator. Her office is at 223 Holtzendorff Hall, phone number is 864.656.3181, and email address is alesias@clemson.edu.