MATH 4500/7500: APPLIED ANALYSIS
SPRING 2023
COURSE SYLLABUS

INSTRUCTOR	Samuel Walsh (`walshsa@missouri.edu`)
TEXTBOOK	*Partial Differential Equations with Fourier Series and Boundary Value Problems (3E)* by NAKHLÉ ASMAR, ISBN 0486807371
LECTURE	MWF 1:00–1:50 PM in 208 Strickland Hall
OFFICE HOURS	W,Th 3:00–4:00 PM in 307 Math Sci. Bldg.
WEBSITE	Canvas

Overview. A partial differential equation (PDE) is an equation relating an unknown function of more than one variable with some combinations of its partial derivatives. For example, if $u = u(x, y)$, then

$$u_{xx} + u_{yy} = 0, \qquad u_{xx} - u_{yy} = 0, \qquad u_x + uu_y = 0$$

are all PDEs. Confronted with an equations like this, we might ask: Do functions u satisfying this statement exist? If so, how many are there? What are their qualitative properties? These issues will sound familiar to you from your study of ODEs. However, for reasons to be discussed, things become considerably more subtle in the PDE setting. Many statements that you can take for granted with ODEs (local existence and uniqueness of solutions to initial value problems, for example) are just not true in general for PDEs.

So why study PDEs, then, aside from pure mathematical curiosity? It turns out that they are absolutely ubiquitous in applications. They arise everywhere from the usual suspects, physics, chemistry, and biology, to less obviously related disciplines like economics and sociology. Phenomena like water waves, diffusion, shock waves, plasma physics, population dynamics — all of them are captured by PDEs. In a sense, the difficulty of PDEs is the price we pay for their universality.

Topics: Solution of the standard partial differential equations (wave, heat, Laplace's eq.) by separation of variables and transform methods; including eigenfunction expansions, Fourier and Laplace transform. Boundary value problems, Sturm–Liouville theory, orthogonality, Fourier, Bessel, and Legendre series, spherical harmonics. Depending on student interest, and the general flow of the class, we may add or subtract items. Please let me know if there is something in particular that you'd like to see covered.

Homework. Homework assignments will be assigned roughly every other week in class. Completed homework must be submitted at the beginning of class the following week. In total, they will account for 40% of your final grade.

You are encouraged to work together on homework. Ultimately, though, each student must submit his/her own assignment. For code, this means that while you and your group members may use the same general approach or algorithm, you should not copy-paste someone else's code. It should go without saying that copying (or lightly reformatting) solutions found online is also not allowed and will result in serious penalties.

Midterms. We will have two in-class midterms: the first on **February 24th** and the second on **March 24th**. In total, they comprise 30% of your course grade.

Final. At the end of the semester, there will be a take-home final exam that must also be done individually. It will be handed out on April 21st and is due the last day of class **Thursday, May 4th**. The final will account for the remaining 30% of your grade.

Disabilities. The goal of the University of Missouri is to ensure an inclusive learning environment for all students. The University of Missouri Disability Center (`https://disabilitycenter.missouri.edu/`) provides services and accommodations for students to participate fully in the learning experience and to experience equitable evaluation of their performance.

Students (including online students) with a documented disability can contact the Disability Center to establish an accommodation plan; see Documented disabilities include hearing, vision, mobility, learning and attention, psychological health, and physical health. Students' accommodations are implemented with the input of students to maximize the learning experiences. The MU Disability Center keeps information about a student's disability confidential.

Please notify me of your eligibility for accommodations as soon as possible. Additionally, if there are aspects of the course that present as barriers, such as inaccessible course content or if you need an immediate accommodation due to an injury, please contact me or contact the Disability Center as soon as possible.

Academic Honesty. Academic honesty is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards academic dishonesty as an extremely serious matter, with serious consequences that range from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, or collaboration, consult the course instructor.

Academic Dishonesty includes but is not necessarily limited to the following: Cheating or knowingly assisting another student in committing an act of cheating or other academic dishonesty. Plagiarism which includes but is not necessarily limited to submitting examinations, themes, reports, drawings, laboratory notes, or other material as one's

own work when such work has been prepared by another person or copied from another person. Unauthorized possession of examinations or reserve library materials, or laboratory materials or experiments, or any other similar actions. Unauthorized changing of grades or markings on an examination or in an instructor's grade book or such change of any grade report.

Academic Integrity Pledge. Students are expected to adhere to this pledge on all graded work whether or not they are explicitly asked in advance to do so: "I strive to uphold the University values of respect, responsibility, discovery, and excellence. On my honor, I pledge that I have neither given nor received unauthorized assistance on this work." The University has specific academic dishonesty administrative procedures. Although policy states that cases of academic dishonesty must be reported to the Office of the Provost for possible action, the instructor may assign a failing grade for the assignment or a failing grade for the course, or may adjust the grade as deemed appropriate. The instructor also may require the student to repeat the assignment or to perform additional assignments. In instances where academic integrity is in question, faculty, staff and students should refer to Article VI of the Faculty Handbook. Article VI is also available in the M-Book. Article VI provides further information regarding the process by which violations are handled and sets forth a standard of excellence in our community.

Intellectual Pluralism. The University community welcomes intellectual diversity and respects student rights. Students who have questions or concerns regarding the atmosphere in this class (including respect for diverse opinions) may contact the departmental chair or divisional director, the Office of Academic Integrity (`https://oai.missouri.edu/about/intellectual-pluralism/`) or the MU Equity Office (`https://equity.missouri.edu/`).

Executive Order N° 38, Academic Inquiry, Course Discussion and Privacy. University of Missouri System Executive Order N° 38 lays out principles regarding the sanctity of classroom discussions at the university. The policy is described fully in section 200.015 of the Collected Rules and Regulations. In this class, students may not make audio or video recordings of course activity, except students permitted to record as an accommodation under section 240.040 of the Collected Rules. All other students who record and/or distribute audio or video recordings of class activity are subject to discipline in accordance with provisions of section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.

Those students who are permitted to record are not permitted to redistribute audio or video recordings of statements or comments from the course to individuals who are not students in the course without the express permission of the faculty member and of any students who are recorded. Students found to have violated this policy are subject to discipline in accordance with provisions of section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.

COVID-19 Policies and Procedures. Students in this course must abide by all University COVID-19 policies and procedures. See:

`https://missouri.edu/covid`

https://provost.missouri.edu/faculty-affairs/syllabus-information/

Mental Health. The University of Missouri is committed to supporting student well being through an integrated network of care, with a wide range of services to help students succeed. The MU Counseling Center offers professional mental care and can help you find the best approach to treatment based on your needs. Call (573) 882-6601 to make an appointment. Any student in crisis may call or go to the MU Counseling Center Monday-Friday between 8:00AM-5:00PM. After hours phone support is available at (573) 882-6601.

Visit https://wellbeing.missouri.edu/ to learn about the valuable services available to you to promote your mental well-being and to help you navigate life challenges while in college.