

Introduction to Partial Differential Equations - MATH 463/513: Spring 2023

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Textbook (optional): *Partial Differential Equations* (Second edition) by Lawrence C. Evans

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Course Outline

1. Derivation of basic Partial Differential Equations (PDE) from physical problems. Heat, wave and Laplace equations. The nonlinear Schrödinger and Klein-Gordon equations. Well-posed problems and classical solutions. Weak solutions. Elementary solution techniques of PDE. Method of separation of variables and transform methods.
2. First order quasilinear and nonlinear PDE. The method of characteristics.
3. Cauchy-Kovalevskaya Theorem.
4. Hyperbolic equations. The wave equation in dimension one (1D) and multi-D. D'Alembert's solution. Solution of mixed initial-boundary problems. The method of reflection. Propagation of singularities. The energy principle.
5. Fourier series and integrals.
6. Elliptic equations. Laplace and Poisson equations. Fundamental solutions and Green's functions. The Dirichlet and Neumann problems. Elementary properties of harmonic functions. Maximum principle. Potential theory. Variational formulations.
7. Parabolic equations. The heat equation. Fundamental solution. Solution of initial value problem. Solution of mixed initial-boundary value problems. The method of reflection. Duhamel's principle. Elementary properties of solutions of the heat equation. Maximum principles. The Burgers equation. Cole-Hopf transform.

COVID-19 Health and Awareness. UNM is a mask friendly, but not a mask required, community. To be registered or employed at UNM, Students, faculty, and staff must all meet UNM's Administrative Mandate on Required COVID-19 vaccination. If you are experiencing COVID-19 symptoms, please do not come to class. If you have a positive COVID-19 test, please stay home for five days and isolate yourself from others, per the Centers for Disease Control (CDC) guidelines. If you do need to stay home, please communicate with me. I can work with you to provide alternatives for course participation and completion. UNM faculty and staff know that these are challenging times. Please let me, an advisor, or another UNM staff member know that you need support so that we can connect you to the right resources. Please be aware that UNM will publish information on websites and email about any changes to our public health status and community response.

Support:

Student Health and Counseling (SHAC) at (505) 277-3136. If you are having active respiratory symptoms (e.g., fever, cough, sore throat, etc.) AND need testing for COVID-19; OR If you recently tested positive and may need oral treatment, call SHAC.

LoboRESPECT Advocacy Center (505) 277-2911 can offer help with contacting faculty and managing challenges that impact your UNM experience.

Accommodations: UNM is committed to providing equitable access to learning opportunities for students with documented disabilities. As your instructor, it is my objective to facilitate an inclusive classroom setting, in which students have full access and opportunity to participate. To engage in a confidential conversation about the process for requesting reasonable accommodations for this class and/or program, please contact Accessibility Resource Center at arcsrvs@unm.edu or by phone at 505-277-3506.

Support: Contact me and contact Accessibility Resource Center (<https://arc.unm.edu/>) at arcsrvs@unm.edu (505) 277-3506. Credit-hour statement (alter as needed to suit your section): This is a three credit-hour course. Class meets for two 65-minute sessions of direct instruction for fifteen weeks during the Spring 2023 semester. Please plan for a minimum of six hours of out-of-class work (or homework, study, assignment completion, and class preparation) each week. OR This is a three credit-hour course delivered in an entirely online modality over 8 weeks during the Spring 2023 semester. Please plan for a minimum of 18 hours per week to learn course materials and complete assignments. Support: Center for Academic Program Support (CAPS). Many students have found that time management workshops can help them meet their goals (consult (CAPS) website under "services"). Title IX: [Note: UNM encourages faculty and TAs to include a Title IX statement on the syllabus and reminds faculty, TAs, and GAs that per university policy UAP 2740 they are required to report gender discrimination, including sexual harassment, sexual misconduct and sexual violence to the Title IX Coordinator at the Office of Compliance, Ethics and Equal Opportunity. Information about how to have a conversation with a student about reporting and what steps to take is available on the Title IX Coordinator page. The Ombuds for Staff runs workshops on that include handling disclosures of sexual harassment (<https://ombudsforstaff.unm.edu/professional-development/index.html>). Faculty may be interested in informational resources, including language that could be used on a syllabus for referral to support services, developed by a group of UNM faculty, Faculty for a Sexual Assault Free Environment at UNM (Faculty SAFE).]

To meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered employees." This designation requires that any report of gender discrimination, which includes sexual harassment, sexual misconduct and sexual violence, made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office Compliance, Ethics and Equal Opportunity (ceeo.unm.edu). For more information on the campus policy regarding sexual misconduct and reporting, see: <https://policy.unm.edu/university-policies/2000/2740.html>.

OR

Our classroom and our university should always be spaces of mutual respect, kindness, and support, without fear of discrimination, harassment, or violence. Should you ever need assistance or have concerns about incidents that violate this principle, please access the resources available to you on campus. Please note that, because UNM faculty, TAs, and GAs are considered "responsible employees" any disclosure of gender discrimination (including sexual harassment, sexual misconduct, and sexual violence) made to a faculty member, TA, or GA must be reported by that faculty member, TA, or GA to the university's Title

IX coordinator. For more information on the campus policy regarding sexual misconduct and reporting, please see: <https://policy.unm.edu/university-policies/2000/2740.html>.

Support: LoboRESPECT Advocacy Center, the Womens Resource Center, and the LGBTQ Resource Center all offer confidential services.

Land Acknowledgement: Founded in 1889, the University of New Mexico sits on the traditional homelands of the Pueblo of Sandia. The original peoples of New Mexico Pueblo, Navajo, and Apache since time immemorial, have deep connections to the land and have made significant contributions to the broader community statewide. We honor the land itself and those who remain stewards of this land throughout the generations and also acknowledge our committed relationship to Indigenous peoples. We gratefully recognize our history. Faculty Resource: Information provided by UNMs Division for Equity and Inclusion can support building an inclusive classroom, <https://diverse.unm.edu/education-and-resources/programs/index.html>. Citizenship and/or Immigration Status: All students are welcome in this class regardless of citizenship, residency, or immigration status. Your professor will respect your privacy if you choose to disclose your status. As for all students in the class, family emergency-related absences are normally excused with reasonable notice to the professor, as noted in the attendance guidelines above. UNM as an institution has made a core commitment to the success of all our students, including members of our undocumented community. The Administrations welcome is found on our website: <http://undocumented.unm.edu/>. Respectful and Responsible Learning: We all have shared responsibility for ensuring that learning occurs safely, honestly, and equitably. Submitting material as your own work that has been generated on a website, in a publication, by an artificial intelligence algorithm, by another person, or by breaking the rules of an assignment constitutes academic dishonesty. It is a student code of conduct violation that can lead to a disciplinary procedure. Please ask me for help in finding the resources you need to be successful in this course. I can help you use study resources responsibly and effectively. Off-campus paper writing services, problem-checkers and services, websites, and AIs can be incorrect or misleading. Learning the course material depends on completing and submitting your own work. UNM preserves and protects the integrity of the academic community through multiple policies including policies on student grievances (Faculty Handbook D175 and D176), academic dishonesty (FH D100), and respectful campus (FH CO9). These are in the Student Pathfinder (<https://pathfinder.unm.edu>) and the Faculty Handbook (<https://handbook.unm.edu>). Support: Many students have found that time management workshops or work with peer tutors can help them meet their goals. These and are other resources are available through Student Learning Support at the Center for Teaching and Learning. Connecting to Campus and Finding Support: UNM has many resources and centers to help you thrive, including opportunities to get involved, mental health resources, academic support including tutoring, resource centers for people like you, free food at Lobo Food Pantry, and jobs on campus. Your advisor, staff at the resource centers and Dean of Students, and I can help you find the right opportunities for you.

Instructors across UNM campuses have boosted academic outcomes and positive engagement by drawing on the Student Experience Project—a UNM-tested and research-based approach to building an inclusive classroom. You can find SEP practices in the SEP Resource Hub, including information in the First Day Toolkit on designing a welcoming and equitable syllabus.