Syllabus - MATH 404 - Introduction to PDEs (draft: August 26) Fall 2025

Course Information

Instructor: Dr. Justin T. Webster (Justin)
Lecture: M, W Sec.1 - 10:00–11:15 pm, Sondheim 209;
TA: Madison Christ, *Email*: mchrist3@umbc.edu
Texts: 1) [free] J. Bell (UMBC), *A First Course in PDE*
`https://jon-bell2.github.io/pde_notes/`
2) [required, e-book] P. DuChateau & D. Zachmann, *Applied PDE*
3) [suggested] W. Strauss, PDEs: An Introduction, 2nd Ed.
Course Website: http://webster.math.umbc.edu/JustinsHomepageForStudents.html

Contact Information

Phone: 410/455-2183
Email: websterj@umbc.edu
Office: MP 430

Office Hours: T, 10:00–11:30am; W, 2:00–3:00pm; and by (in-person or virtual) appt.*
TA Office Hours: Th and F, 10:00–11:00 in a library study room

This is a three credit-hour course that is meant to be an introduction to *partial differential equations* (PDEs) in application. As per the catalog, topics covered include: linear and quasi-linear first order equations, method of characteristics, linear second order equations, derivations (of equations), classifications, and fundamental solutions, integral transforms, self-adjoint operators, Sturm-Liouville problems and eigenfunction expansions, Fourier series, boundary and initial value problem for potential, wave, and heat equations, Green's functions, and distributions.

Real Prerequisites: MATH 225 (Intro DEs) and MATH 251 (Multivar. Calc.) with a grade of "C" or better.

The following are the course policies, which may be changed at any time; changes will be announced *in class*.

Contacting Me: I will be in my office during Office Hours—no appointment required. If I am not, I will post a note on my door that we have moved to an overflow room. The best way to contact me is via email. I will respond within 36 hours, but do not expect an immediate response. **Please schedule all appointments outside of office hours through e-mail, with at least 24 hour notice.* Students are responsible for all announcements made in class, and any e-mail sent to their UMBC email account. The course will primarily run through my homepage; please check it weekly.

Reading: The course content necessitates intensive *out of class* reading—examples, definitions, theorems, and proofs. As such there will be weekly required reading (with due dates). Often the reading will be due before content is presented in lecture. *The primary purpose of the mandatory and suggested texts is to provide additional examples and discussion.*

Assignments: Homework will be assigned (in addition to the reading) approximately every three lectures. These varied problem sets will be drawn from multiple sources and collected in a .pdf file that I will post. Due dates will be made clear in that file and on the homepage. A broad range of question types will be assigned, and the size of the homeworks may change as we move through the course—though each homework will be worth the same point value. You are encouraged to work together, but you must turn in your own solutions, independently presented. A random selection of the problems on each homework will be graded, and selected solutions may be posted. It is strongly suggested that homework solutions are typeset in LaTeX[1]; if you hand-write your solutions, they must be pristine (*if the grader cannot easily follow your work, it will be assigned a zero*). **The lowest homework score will be dropped.**

Quizzes/Activities: A quiz or group activity will happen approximately every other week. Quizzes may be longer (30 min) or shorter (5 min, basic comprehension/reading check), depending on the material. Once material is covered in class or assigned for reading, it is valid for quizzes. Graded in-class activities will happen a few times during the semester. Quizzes and Activities constitute one grade category. *No make-ups will be granted, but you will be permitted* **one quiz/activity drop.** There will be no 75 minute tests during the semester.

Term Paper: By the end of Week 1, a term paper will be assigned, due on Monday, December 1st (no extensions). The term paper will be a research paper (with appropriate citations) of roughly 12 pages (double-spaced, with embedded mathematical content but excluding bibliographical information), covering an advanced topic of the student's choosing

[1] LaTeX is type-setting software utilized by the greater STEM community for cleanly, clearly, and efficiently presenting mathematics. It does take some getting used to, and can be frustrating at first, but in the long run it will save you time and energy, and accelerate your transition to mathematical maturity. Download: `https://latex-project.org/ftp.html`; hosted environment: `https://www.overleaf.com/`.

from PDEs. I will provide example prompts, but students are free to choose an appropriate topic—please check with me if you are not utilizing the prompts. *The texts DuChateau/Zachmann and Strauss will be helpful for this paper.*

Final Exam: There will be a comprehensive final exam. The date and time of the final are *absolutely* fixed, and only in the most extreme cases will arrangements be made to reschedule.

Final Exam Date - Monday, December 15th, 10:30 am–12:30 pm

Notes Policy: Books, notes, and calculators are not allowed for any quizzes or the exam *unless explicitly stated.*

Grading: Grades will be assigned based on raw percentages in the standard 100 percent scale (with no "+" or "−"). *During the semester, grades will not be rounded, and there will be no curve for graded material.* However, I reserve the right to adjust final grades based on factors such as attendance, participation, and demonstrated effort towards understanding the material. I also reserve the right to perform a "mean-shift" to the the final course distribution (always upward, if at all). The final grade breakdown will be as follows:

Final Exam – 30% Assignments – 30% Quizzes/Activities – 25% Term Paper – 15%

Course Description and Outcomes: Students are expected to display a thorough understanding of the topics covered. In particular, upon completion of the course students should:

+) Be able to confirm a solution of a PDE.
+) Be able to characterize a PDE as: (i) linear, semi-linear, quasi-linear, or nonlinear, (ii) homogeneous or nonhomogeneous, (iii) order, (iv) parabolic, hyperbolic, or elliptic (for 2nd order PDEs).
+) Understand the derivation of several classic PDEs such as wave, transport, and diffusion equations.
+) Be able to solve 1st order, linear or semi-linear PDEs using method of characteristics.
+) Be able to derive the heat kernel.
+) Be able to use the heat kernel to solve the heat equation on an infinite domain.
+) Be able to apply Duhamel's principle to change non-homogenous equations.
+) Be able to solve the wave equation using d'Alembert's solution.
+) Understand the domain of dependence, as well as dispersion and dissipation (for the telegrapher's equation).
+) Be able to apply Fourier and Laplace transforms to reduce PDEs.
+) Understand interpretation of Neumann, Dirichlet, and Robin boundary conditions.
+) Be able to apply separation of variables to PDEs and solve the associated eigenvalue problems.
+) Be able to calculate Fourier series solutions and their coefficients.
+) Be able to calculate solutions to the (Sturm-Liouville) eigenvalue problem.
+) Understand the formulation of Boundary-Value and Initial-Boundary-Value problems on spatially bounded domains.
+) Understand what a Green's function is and how to calculate it.
+) Understand the variational formulation of a BVP and basic associated concepts.

These outcomes will be assessed on homework, quizzes, and the final exam.

Etiquette, Please: Make sure your cell phone is silent, and don't be egregious about using it, and *do not use laptops during class*—tablets and note-taking devices are permitted. If choosing to attend, please come on time and commit to sitting through the entire lecture. Lastly, please comment and ask questions during the lecture by raising your hand.

Attendance: Attendance will not factor into the overall grade, but there are obvious ramifications for missing more than a couple class sessions. I will record absences for a student if they occur in excess.

Important Dates: Please be aware of the following dates:

Labor Day (no class) - Sep. 1;	add/drop deadline - Sep. 10;
withdraw deadline - Nov. 5;	Thanksgiving break - Nov. 26–28
last day of classes - Dec. 9;	finals - Dec. 11–17.

Course Evaluations and Feedback: I take course evaluations seriously, and as such, I would ask that you complete them. Please provide objective and honest feedback in as much detail as you can. Additionally, polite feedback about the course (during the semester) is encouraged.

Other Stuff:

Academic Integrity: Do not cheat! If I find out, I will make it embarrassing for you; and otherwise, CHEATING. MAKES. YOU. A. BAD. PERSON. This is an elective course relevant to your STEM field of study! Here is the *UMBC Academic Integrity Policy*: By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, the UMBC Integrity webpage `https://academicconduct.umbc.edu/`, the UMBC Undergraduate Student Academic Conduct Policy for undergraduate students, the UMBC Policies section of the UMBC Directory or the University of Maryland Graduate School, Baltimore (UMGSB) Policy and Procedures for Student Academic Misconduct for graduate students.

Athletes, Veterans, and Other Considerations: If you are a NCAA or club sports athlete, or have *any* special circumstances, you should inform me as soon as possible. For veterans, certain additional resources may be available: `http://veterans.umbc.edu/`. Special accommodations can be made for scheduling and other specific needs on an individual basis. Please inform me of your situation as soon as possible. For disability-related needs, documentation may be required.

ADA Guidance and Resources: Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities. If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at `sds.umbc.edu` for registration information and office procedures. SDS email: `disAbility@umbc.edu`; SDS phone: 410-455-2459.If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations.

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination: UMBC Policy and Federal law (Title IX) prohibit discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment or retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources: Leah Reynolds, Interim Title IX Coordinator (410-455-1717), `lreynol1@umbc.edu`. You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community. If you are interested in or thinking about making a report, please use the Online Reporting/Referral Form. Please note that, if you report anonymously, the University's ability to respond will be limited.

Notice that Faculty and Teaching Assistants are Responsible Employees with Mandatory Reporting Obligations: All faculty members and teaching assistants are considered Responsible Employees, per UMBC's Policy on Sexual Misconduct, Sexual Harassment, and Gender Discrimination. Faculty and teaching assistants therefore required to report all known information regarding alleged conduct that may be a violation of the Policy to the Title IX Coordinator, even if a student discloses an experience that occurred before attending UMBC and/or an incident that only involves people not affiliated with UMBC. Reports are required regardless of the amount of detail provided and even in instances where support has already been offered or received. *While faculty members want to encourage you to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report past and present sexual harassment, sexual assault, domestic and dating violence, stalking, and gender discrimination that is shared with them to the Title IX Coordinator so that the University can inform students of their rights, resources, and support. While you are encouraged to do so, you are not obligated to respond to outreach conducted as a result of a report to the Title IX Coordinator.*
If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of Confidential Resources available to support you:

- Retriever Integrated Health (Main Campus): 410-455-2472; Monday – Friday 8:30 a.m. – 5 p.m.; For After-Hours Support, Call 988.
- Center for Counseling and Well-Being (Shady Grove Campus): 301-738-6273; Monday-Thursday 10:00a.m. – 7:00 p.m. and Friday 10:00 a.m. – 2:00 p.m. (virtual) Online Appointment Request Form
- Pastoral Counseling via The Gathering Space for Spiritual Well-Being: 410-455-6795; i3b@umbc.edu; Monday – Friday 8:00 a.m. – 10:00 p.m.

- Women's Center (open to students of all genders): 410-455-2714; womenscenter@umbc.edu; Monday – Thursday 9:30 a.m. – 5:00 p.m. and Friday 10:00 a.m. – 4 p.m.
- Additional on and off campus supports and resources can be found at: `https://ecr.umbc.edu/`.

Please note that Maryland law and UMBC policy require that faculty report all disclosures or suspicions of child abuse or neglect to the Department of Social Services and/or the police even if the person who experienced the abuse or neglect is now over 18.
UMBC's Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination expressly prohibits all forms of discrimination and harassment on the basis of sex, including pregnancy. Resources for pregnant, parenting and breastfeeding students are available through the University?s Office of Equity and Civil Rights. Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and ensure ongoing access to their academic program with respect to a leave of absence ? returning following leave, or any other accommodation that may be needed related to pregnancy, childbirth, adoption, breastfeeding, and/or the early months of parenting.

Pregnant and Parenting Students: In addition, students who are pregnant and have an impairment related to their pregnancy that qualifies as disability under the ADA may be entitled to accommodations through the Office of Student Disability Services.

Religious Observances & Accommodations: UMBC Policy provides that students should not be penalized because of observances of their religious beliefs, and that students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences or requested modifications for religious observances in advance, and as early as possible. For questions or guidance regarding religious observances and accommodations, please contact the Office of Equity and Civil Rights at ecr@umbc.edu.

Hate, Bias, Discrimination and Harassment: UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement. Consistent with these principles, UMBC Policy prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information. Students (and faculty and staff) who experience discrimination, harassment, hate, or bias based upon a protected status or who have such matters reported to them should use the online reporting/referral form to report discrimination, hate, or bias incidents. You may report incidents that happen to you anonymously. Please note that, if you report anonymously, the University?s ability to respond may be limited.