ILLINOIS

Math 442: Introduction to Partial Differential Equations

Offered through NetMath

Academic Year 2026-2027 Term, 16-week course

Instructor Information

Instructor – ***Qumar Hussain***

- Contact information: qhussain@illinois.edu
- By appointment via Canvas 12:30pm - 01:30pm on Tuesday

Course Information

Credit Hours

3 credit hours

Course Description

Introduces partial differential equations, emphasizing the wave, diffusion and potential (Laplace) equations. Focuses on understanding the physical meaning and mathematical properties of solutions of partial differential equations. Includes fundamental solutions and transform methods for problems on the line, as well as separation of variables using orthogonal series for problems in regions with boundary. Covers convergence of Fourier series in detail.

Prerequisite

MATH 241; MATH 284, MATH 285, or MATH 441

Course Objectives:

Students will learn different methods for solving the PDEs along with some of the applications in the physical systems such as harmonic oscillators, special relativity and hydrogen atom. The focus will be on understanding the physical meaning and mathematical properties of solutions of partial differential equations.

Course Content:

1. First order linear partial differential equations, initial and boundary conditions, well-posed problems, geometric method and coordinate method for solving first order PDE.
2. Second order PDEs, types of second order PDEs, different methods for solving second order PDEs including operator method, Fourier coefficient method, separation or variables method, spherical means method, Green's function formula, Duhamel's principle.
3. Wave equation, principle of causality, diffusion equation, Maximum principle, reflection of waves, waves equation with a source, diffusion equation with a source, well posedness of the wave equation. Separation of variables with Dirichlet, Neumann and Robin boundary conditions. Heat and wave equation in higher dimensions, radial functions.
4. Fourier coefficient method for homogeneous and inhomogeneous wave, diffusion based on even, odd, periodic and complex functions, Orthogonality and convergence. Method of shifting data for inhomogeneous diffusion equations.
5. Laplace Equation with Robin BC, Energy problem, Eigen functions, homogeneous and inhomogeneous periodic differential equation, harmonic boundary problem.
6. PDE based modelling of simplest atom (Schrodinger equation), Harmonic oscillator, hydrogen atom, vibrations of drumhead, solid vibration in a ball.
7. Inner product spaces, Cauchy Schwarz inequality, Green Identity, Hilbert spaces, convergence and orthonormal systems, different types of convergence, harmonic function, Bessel's inequality, Theorem on Continuous derivatives and pointwise convergence, divergence theorem, Weierstrass approximation theorem.

Course Structure:

This course is fully online and asynchronous. Students have 16 weeks from their course start date to complete the course. The course is self-paced, and students may complete their coursework prior to the assigned end date. However, students are encouraged to follow the guided structure provided by the instructor with suggested deadlines for assignments and exams. As this is a 3-credit hour course, students are expected to dedicate 9 hours per week to learning course content.

Exams:

Information	Exam 1	Exam 2	Exam 3	Final Exam
Coverage:	Unit 1-3 Lecture 1-12	Unit 4-6 Lecture 13-22	Unit 7-9 Lecture 23-34	Comprehensive
Time Limit:	90 Minutes	90 Minutes	90 Minutes	3 Hours

All exams will be administered online, free of charge to students. Exams are administered using ProctorU Record+. More information on taking exams.

Calculators are not permitted or required for NetMath exams.

The use of outside sources is prohibited.

Refer to the Academic Integrity policies below in the syllabus for more details.

Scratch paper is allowed during exams.

Exams must be taken in course order and students should not take more than 1 exam within a 24-hour period.

Grading:

Grading Breakdown:

Component	Weight
Homework	20%
Exam 1	16%
Exam 2	16%
Exam 3	16%
Final Exam	32%

Letter Grade Scale:

Percentage	Letter Grade
97 - 100	A+
93 - 96	A
90 - 92	A-
87 - 89	B+
83 - 86	B
80 - 82	B-
77 - 79	C+
73 - 76	C
70 - 72	C-
67 - 69	D+
63 - 66	D
60 - 62	D-
59 and below	F

Final grades are rounded to the nearest integer before applying the scale above.

Grades are not curved.

Once you complete your exam, you will receive a 0 on any homework leading up to that exam that has not been submitted. Under special circumstances, students may request that they be allowed to submit these assignments. This is left to the discretion of the course instructor.

Students are encouraged to follow the guided deadlines in their course. However, as our courses are self-paced, students may occasionally submit several assignments in a short period of time. Please note that instructors are only expected to grade one exam per five-business-day week, and instructors are only expected to grade up to two submitted assignments per five-business-day week. Under special circumstances, students may request that additional assignments be graded. This is left to the discretion of the course instructor.

Due to the rolling enrollment structure of the NetMath program, instructor workloads vary throughout the year. During peak periods, response times and grading turnaround may be longer than usual. Students should expect significant delays in grading and instructor responses between June and August.

Communication:

You may reach out to the instructor via email, post to the course forum, or attend office hours.

If you experience consistent and significant delays in reaching your instructor, please contact instruction@netmath.illinois.edu with your concerns.

If you have non-course specific questions, you may reach out to the NetMath office. It is recommended to review the NetMath website first as it often has the answers you need.

General Inquiries: netmath@illinois.edu

Proctoring Questions: proctor@netmath.illinois.edu

Technology Questions: tech-staff@netmath.illinois.edu

Main Office Phone: (217) 265-0439

Phone hours: Monday - Friday, 9am - 12pm & 1pm - 4pm CST

Textbook:

Walter A, Strauss. (2016). *Partial Differential Equations: An Introduction, Second Edition.* John Wiley & Sons, Inc.

Technical Requirements:

Students are expected to have a device with an up-to-date operating system to access their course materials, reliable internet access, and must meet the requirements set by ProctorU for exam proctoring. NetMath IT - Frequently Asked Questions.

Other Information:

This is an online course featuring video lectures from the UIUC Spring 2018 course taught by Professor Marius Junge.

Policies:

Accommodations:

The University of Illinois Champaign-Urbana, is committed to ensuring that all students, including students with disabilities, do not experience barriers to learning and participating fully in class. Students who have a letter of accommodation from DRES are advised to share that with their instructor and NetMath staff at instruction@netmath.illinois.edu as soon as possible to ensure accommodation needs can be discussed and met.

Students enrolled in a degree program at another institution may refer to their home institution's student services or disability office for accommodations. Current, non-expired documentation from other institutions listing the specifics of an accommodation is acceptable and should be sent to instruction@netmath.illinois.edu.

To obtain disability-related academic accommodations, disabled students must contact Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, please visit 1207 S. Oak Street, Champaign, call (217) 333-1970, email disability@illinois.edu, or visit the DRES website.

Academic Integrity:

The University of Illinois Urbana-Champaign *Student Code* (https://studentcode.illinois.edu/) should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy (https://studentcode.illinois.edu/article1/part4/1-401/). Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

AI Large Language Models (such as ChatGPT, Claude, Gemini, etc.) are prohibited during exams. Using these during the exam will be considered a violation of academic integrity and may incur sanctions as outlined in the Illinois Student Code. Students should be aware the exam proctoring process involves screen recording of the computer. While AI will not be strictly prohibited for homework as they can be useful tools for studying and brainstorming, students are strongly encouraged to work on the homework themselves or collaborate with peers when appropriate. Students are required to submit their own work and answers. This improves learning outcomes and best prepares students for exams. Homework is designed to help students understand the content and develop skills. Students may be unprepared for exams if there is heavy reliance on AI.

Students are expected to follow the University guidance on intellectual property. Students are not to share course content outside of the course.

Campus Holidays:

Instructors are expected to respond to student communications and grade homework assignments in a timely manner. Observed Campus Holidays, illness, personal obligations, or other circumstances outside the instructor's control may affect normal grading and response time. If you experience consistent and significant delays, please contact instruction@netmath.illinois.edu with your concerns.

Extensions:

Students in this course are eligible for up to two 1-month course extensions. There is a non-refundable $350 fee for each approved extension. Students should review the extension guidelines for more information.

FERPA:

See FERPA – Office of the Registrar (https://registrar.illinois.edu/academic-records/ferpa/) for more information on the Family Educational Rights and Privacy Act (FERPA).

Any student who has suppressed their directory information pursuant to FERPA should self-identify to the instructor to ensure protection of the privacy of their attendance in this course.

Mental Health:

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Health Service Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

Counseling Center or (217) 333-3704

McKinley Health Center or (217) 333-2700

National Suicide Prevention Lifeline or (800) 273-8255

Rosecrance Crisis Line or (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

*This statement is approved by the University of Illinois Counseling Center

Sexual Misconduct Reporting Obligation:

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including supportive measures, resources, the campus disciplinary process, and law enforcement options.

Designated Confidential Employees: A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality.

Other information about resources and incident reporting.