PDE I (MAT7068) Syllabus
Fall 2024

Instructor: Linlin Su (苏琳琳)**,** College of Science M5013, sull@sustech.edu.cn

Office Hours: Tues. 14:00-16:00 or by appointment

Grader: Zhannan Zhuang (庄展楠)**,** College of Science M3015, 12231276@mail.sustech.edu.cn

Prerequisites: Undergraduate courses of PDE, Real Analysis (Lebesgue theory), Functional Analysis

Class Schedule: Mon. (odd weeks), Teaching Bldg 3, RM310, 10:20am-12:10pm
Wed. (every week), College of Business, RM206, 10:20am-12:10pm

QQ Group: 785680168

Textbook: Partial Differential Equations, 2nd edition (reprint of 2015), by Lawrence C. Evans.

References:

1.《椭圆与抛物型方程引论》，伍卓群、尹景学、王春朋著，2003 年科学出版社出版.

2. Elliptic Partial Differential Equations of second Order, by David Gilbarg and Neil S. Trudinger, Springer.

3. Partial Differential Equations, 2nd edition, by Robert C. McOwen, Prentice-Hall.

4. Maximum Principles in Differential Equations, by Murray H. Protter and Hans F. Weinberger, Springer.

Course Policies:

- The **semester grade** will be given according to performance in **homework (40%), midterm (20%), and the final exam (40%)**.
- Homework will be assigned, collected and graded. **No late homework will be accepted.**
- There will be **one midterm exam**, lasting two hours and given in the lecture class. **Tentative date of the midterm** is **Wednesday, Nov. 6, in class.**
- Missing the **midterm** or **final exam** without prior notification to and approval of me will automatically result in the "**0**" grade for the exam.

Course Contents:

- Classical weak and strong maximum principles for 2nd order elliptic and parabolic equations, Hopf boundary point lemma, and their applications.
- Sobolev spaces, weak derivatives, approximation, density theorem, the Sobolev inequalities, the Kondrachov compact imbedding.
- L^2 theory for second order elliptic equations, existence via the Lax-Milgram Theorem, Fredholm alternative, L^2 estimates, the Harnack inequality, eigenvalue problem for symmetric and non-symmetric second order elliptic operators.

PDE II (spring semester)

- L^2 theory for second order parabolic and hyperbolic equations, existence via the Galerkin method, uniqueness and regularity via energy method.
- A brief introduction to elliptic and parabolic regularity theories, the L^p and Schauder estimates.
- Nonlinear elliptic equations, variational method—the direct minimization method, method of upper and lower solutions, fixed point method.
- Nonlinear parabolic equations, global existence, stability of steady states, traveling wave solutions.
- Conservation laws, Rankine-Hugoniot jump condition, uniqueness issue, vanishing viscosity method, entropy condition, Riemann problem for Burger's equation, p-systems.