Information on MATH8770

Class Time: 1:25pm–2:15pm, Monday, Wednesday and Friday
Classroom: Graduate Studies Building Room 326
Textbook: Partial Differential Equations, L. Evans, AMS Publications, 1998
Instructor: Dr. Ming-Jun Lai
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We use the textbook "Partial Differential Equations" written by L. Evans. The author presents the basic mathematical theory on PDE's clearly and in self-contained fashion. I plan to cover only Chapters 1, 2, 5, 6 in this semester. I hope these generate enough interest in you so that you may continue studying the remaining chapters and beyond or we can have a class in the summer. I still feel that we need to learn more on numerical methods to solve various linear and nonlinear PDE's. We will have MATH8510 in the fall for numerical methods for PDE's.

In addition, I hope you will learn some phyiscal backgrounds where the PDE's come from so that we are able to interpret the numerical solutions in the physical meaning. This will make you to have a comprehensive knowlege on PDE's.

Finally, I hope we will have a chance to study some special PDE's such as Navier-Stokes equations in the near future. Usually, the special PDE's are nonlinear PDE's. As the author says in the textbook: "We know too much on linear PDE's, but too little on nonlinear PDE's". There are too much variaties on nonlinear PDE's. We have to study each type of nonlinear PDE's.

I plan to assign four homework sets.

Tentative Schedule

1/8	Introduction	§1.1 & §1.2
1/10	Typical PDE's	§1.2 & §1.3
1/11	A system of PDE	3:30pm–4:30pm
1/12	Transport Equations	§2.1
1/15	MLK (no class)	
1/17	Laplace's Equations	§2.2.1
1/19	Mean-Value Formulas	§2.2.2
1/22	Harmonic Functions	§2.2.3
1/24	Green's function	§2.2.4
1/26	Energy Methods	§2.2.5
1/29	Heat Equations	§2.3.1
1/31	Fundamental Solution	§2.3.2

2/2	Properties of Solution	§2.3.3
2/5	Energy Methods	§2.3.4
2/7	Wave Equations	§2.4.1
2/9	Wave Equations(CONT.)	§2.4.2
2/12	Energy Methods	§2.4.3
2/14	Sobolev Spaces	§5.1 & §5.2
2/16	Sobolev Space(CONT.)	§5.2.3
2/19	Approximation	§5.3.1
2/21	Approximation(CONT.)	§5.3.2
2/23	Extensions	§5.4
2/26	Trace Theorem	§5.5
2/28	Sobolev Inequalities	§5.6.1
3/2	Sobolev Inequalities (CONT.)	§5.6.2
3/5	Problem Session	
3/7	Problem Session	
3/9	No class	
3/12–3/16	Spring Break	
3/19	More Sobolev Inequalities	§5.6.3
3/21	Compactly Embedding	§5.7
3/23	Poincare's Inequalities	§5.8.1
3/26	Difference Quotients	§5.8.2
3/28	Differentiability	§5.8.3
3/30	The space H^{-1}	§5.9.1
4/2	The space involving time	§5.9.2
4/4	Elliptic Equations	§6.1.1
4/6	Weak Solutions	§6.1.2
4/9	Lax-Milgram Theorem	§6.2.1
4/11	Energy Estimates	§6.2.2
4/13	Fredholm Alternative	§6.2.3
4/16	Interior Regularity	§6.3.1
4/18	Boundary Regularity	§6.3.2
4/20	Maximum Principles	§6.4.1
4/23	Maximum Principles	§6.4.2
4/25	Harnack's Inequality	§6.4.3
4/27	Eigenvalues	§6.5.1
4/30	Eigenvalues(CONT.)	§6.5.2