Math 512 – Partial Differential Equations

Course Description from Bulletin: Basic model equations describing wave propagation, diffusion and potential functions; characteristics, Fourier transform, Green function, and eigenfunction expansions; elementary theory of partial differential equations; Sobolev spaces; linear elliptic equations; energy methods; semigroup methods; applications to partial differential equations from engineering and science. (3-0-3)

Enrollment: Elective for AM and other majors.

Textbook(s): R. C. McOwen (2003), Partial Differential Equations, second edition, Prentice Hall. ISBN 0-13-009335-1.
M. Renardy and R. C. Rogers (2004), An Introduction to Partial Differential Equations, second edition. Springer. ISBN 0-387-00444-0.

Other required material:

Prerequisites: MATH 461 or MATH 489 or consent of the instructor

Objectives:

1. Students will understand the basic methods for solving the Laplace, heat, and wave equations.
2. Students will learn basic theory and modern techniques for understanding solutions of more general partial differential equations.
3. Students will improve their problem solving skills in applied analysis of partial differential equations.
4. Students will improve their presentation and writing skills.

Lecture schedule: 3 50 minutes (or 2 75 minutes) lectures per week

Course Outline:	Hours
1. First order equations	4
a. Method of characteristics	
b. Weak solutions	
c. Conservation laws	
d. Nonlinear equations	
2. Wave equation	4
3. Laplace equation	4
4. Heat equation	4
5. Sobolev spaces and imbedding theorems	6
6. General theory	10
a. Existence and uniqueness of solutions	
b. Maximal principles	
c. Weak solutions and regularity	
d. Eigenvalues and eigenfunctions of elliptic operators	
7. Energy methods	5
8. Semigroup methods	5

Assessment:	Homework	10-30%
	Computer Programs/Project	10-20%
	Quizzes/Tests	20-50%
	Final Exam	30-50%

Syllabus prepared by: J. Duan
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