MATH 832 : PARTIAL DIFFERENTIAL EQUATIONS II
Spring 2009

Instructor: Dejan Slepčev
Lectures MWF at 10:30 in PPB 300
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Text: *Partial Differential Equations*, by Lawrence C. Evans, AMS 2002.

Problem Sets. There will be 6 problem sets. The problem sets and due dates will be posted on the course blackboard page. Late homework will not receive score. However, if you have a valid reason for not doing a problem set (illness for example), the particular homework will not count towards your grade.
Discussing the problem sets with your classmates is fine, as long as you are only exchanging ideas and general knowledge, and not the solutions to the problems. In particular everyone should present his/her own solutions.

Project and presentation. Each student will be required to do a project on a topic that goes beyond the material covered in class. Most of the projects are based on reading journal articles and/or book chapters. At the end of the semester everyone will give a presentation. Details on the project as well as a list of suggested topics/articles will be provided in class.

Evaluation. Final grade will be base on: 2/3 homework + 1/3 (project report + presentation).

OUTLINE

I. **Sobolev spaces: Notation and brief review (Evans Ch. 5)**

II. **Elliptic Equations (Evans Ch. 6)**

1. Existence of weak solutions
2. Fredholm alternative
3. Regularity of solutions
4. Eigenvalues and eigenfunctions

III. **Parabolic Equations (Evans Sec. 7.1)**

1. Sobolev spaces with time component (Evans Sec. 5.9)
2. Existence of weak solutions (Galerkin approximation)
3. Regularity of weak solutions
4. Nonlinear diffusion (if time permits)

IV. **Calculus of Variations (Evans Ch. 8)**

1. Introduction
2. First variation, Euler–Lagrange equation, Second variation
3. Existence of minimizers
4. Regularity of minimizers
5. Problems with constraints

V. **Selected topics** (may change as we go along)

1. Fixed point theory
2. Semigroup theory (Evans Sec. 7.4)
3. Gradient flows (Evans 9.6)
4. Problems with multiple scales (Γ convergence, Homogenization)
5. Scaling and self-similarity