SPRING 2012
COURSE ANNOUNCEMENT

Math 8590: Topics in Partial Differential Equations
MWF 12:20 PM – 1:10 PM, VinH 2

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Office Hours: MWF 1:30 PM – 2:15 PM, or by appointment

We tentatively plan to cover the following subjects.

1. Existence of classical solutions to the initial and boundary value problems (Dirichlet problem, oblique derivative problem, etc) for second order elliptic and parabolic equations with Hölder coefficients.

2. Properties of solutions of second order elliptic and parabolic equations with *measurable* coefficients in *non-divergence* or *divergence* forms: Hölder regularity of solutions, interior and boundary Harnack inequalities, etc.

3. Applications to nonlinear equations: regularity of solutions to fully nonlinear equations, existence of blowup solutions for semilinear elliptic equations.

Our main tools are the classical maximum (or comparison) principle and energy estimates. These estimates are very useful in combination with local smoothness of harmonic functions or solutions to the heat equation. They allow us to prove the existence of classical solutions to different boundary value problems for elliptic and parabolic equations with Hölder coefficients without using representations of solutions in terms of solid and layer potentials. This approach works for nonlinear equations as well, when there are no explicit representations of solutions available.

Lecture notes will be provided for the main part of the course.

PREREQUISITES: Some knowledge of Real and Functional Analysis (Lebesgue integral, Banach and Hilbert spaces).

For supplementary reading, one can use the books:

L. C. Evans, *Partial Differential Equations*, Graduate Studies in Mathematics, Vol. 19, 1998 (or 2nd Edition, 2010).

D. Gilbarg and N.S. Trudinger, *Elliptic Partial Differential Equations of Second Order*, Springer, 2nd Edition, 1983 (or more recent 3rd Edition).

N. V. Krylov, *Lectures on Elliptic and Parabolic Equations in Hölder spaces*, Graduate Studies in Mathematics, Vol. 12, 1996.

EVALUATION. The grade will be based on 3 or 4 homework projects.