

Theory of partial differential equations  
MWF 9-9:50am  
CB343  
Spring 2013

Instructor: Russell Brown  
Office: POT741  
Phone: 257-3951  
rbrown@uky.edu  
Office Hours: MWF 10-11  
and by appointment

**Grading:** Grades will be based on homework, two take home assignments/tests, and a presentation based on a paper. The homework will be worth 50 points, the presentation will be worth ten points and each of the longer assignments will be worth 20 points. Collaboration will be encouraged on the homework. The longer assignments should be worked only with the assistance of the instructor.

**Text:** *Partial differential equations, 2nd edition*, AMS, L. Craig Evans.

We will cover Chapters 5, 6 and part of 7. Chapter 5 surveys the theory of Sobolev spaces. We extend the notion of a partial derivatives to a larger class of functions. A Sobolev space is a complete vector space of functions with derivatives in an  $L^p$ -space. These spaces are complete in a convenient topology. Convenient means that we have enough convergent sequences to make it reasonably easy to establish existence of solutions by various approximation or limiting schemes. Then we consider the regularity of these solutions. That is can we show that the solutions obtained in a Sobolev space is continuously differentiable in the classical sense. Chapter 6 gives the existence and regularity theory for elliptic equations. Chapter 7 gives existence and regularity theory for elliptic equations. If time permits we will discuss the de Giorgi-Moser-Nash theory of regularity of weak solutions of elliptic equations in divergence form.

**Homework:** Homework will be assigned and collected regularly. You should endeavor to write out your homework clearly. Use complete sentences. Give specific references to results that you use. Note that homework is a substantial fraction of your grade.

Be aware that your instructor is old and cranky. Late homework will not be accepted. You may write on at most one side of each sheet of paper. Leave generous margins. I may use the margins and the back of each sheet for comments. You may also find that your instructor is a bit distracted. Please ask if you do not understand my comments. You may write your homework out by hand.

Below are some references that may be useful.

- Michael Taylor, *Partial Differential Equations vol. I-III*.
- Fritz John, *Partial Differential Equations*.
- G.B. Folland, *Introduction to Partial Differential Equations*.
- D. Gilbarg and N.S. Trudinger, *Elliptic partial differential equations of second order*

- H.F. Weinberger, *A First Course in Partial Differential Equations With Complex Variables and Transform Methods*.

January 8, 2013