

King Fahd University of Petroleum and Minerals  
 Department of Mathematical Sciences  
**SYLLABUS**  
 Semester I, 2006-2007 (061)  
 (Dr. Salim Messaoudi)

**Course #:** Math 695  
**Title:** Reading and Research I  
**Textbook:** 1. Adams R., *Sobolev Spaces*, Academic Press 1975.  
 2. L. Evans, *Partial Differential Equations*, AMS 1998.  
 3. McOwen, *Partial Differential Equations, Methods and Applications*, Prentice Hall  
**References** 4. Brezis H, *Analyse fonctionnelle Theorie et applications*, Second Edition, Dunod, Paris 1999.  
 5. Chipot M., *Elements of nonlinear analysis*, Birkhuser 2000.  
 6. Lions J.L., *Quelques methodes de resolution des problemes aux limites non lineaires*, Second Edition, Dunod, Paris 2002.

**Objective** This course is intended to expose the audience to Sobolev spaces and some of their applications in solving linear partial differential equations. It also opens the route for further advances courses and research in the domains of PDE's.

Week #	Topic
1	<u>Review of the Lebesgue spaces</u> : Definitions, Properties, Riesz representation theorem (RRT).
2	<u>Sobolev spaces on R</u> : weak derivatives, Definitions, properties
3	<u>Extension and Density</u> : Extension operator, Theorems
4 & 5	<u>Imbedding</u> : imbedding theorems, compact imbedding
6	<u>The space <math>W^{m,p}(\Omega)</math></u> : Definitions, properties, theorems, Dual spaces.
7 & 8	<u>Applications to PDE's</u> : Lax-Milgram Lemma, Solution of PDE' s, Regularity, Maximum Principle.
9	<u>Approximation and Finite Element Method (Brief)</u>
10 - 12	<u>Sobolev spaces on <math>R^n</math></u> : Weak derivatives, Definitions, Properties, Extension, Imbeddings, Sobolev inequalities, Trace.
13	<u>Applications to Elliptic problems</u> : Existence, Uniqueness,
14	<u>Maximum Principle</u>
15	Variational problems.

**Evaluation:** Homework + Midterm + Final Exam

