

**MATH 690 R** (Advanced Topics in Mathematical Physics), **Control of Quantum Systems** (Spring 2004)

3 Credits, Time and Place TBA

Instructor: D. D'Alessandro

Department of Mathematics

440 Carver Hall

e-mail: daless@iastate.edu

<http://www.public.iastate.edu/~daless/>

This is a new subject in Mathematics and Physics which has great potential applications because of the recent advances in pulse shaping and laser technology. You will learn how to control chemical reaction, the spin and the position of an electron and how these applications lead to meaningful and interesting mathematical problems.

The subject is a combination of quantum theory and control theory but it is very much interdisciplinary and by attending this course you will also learn about Lie Groups and Lie Algebras and associated techniques as applied to Physics. I am planning to write lecture notes as the course unfolds and assign homework. Grade will be decided based on homework. We will have a meeting in my office on the first day of classes at 3 PM to decide time and location for the course

**Syllabus:**

1. Introduction to Quantum Mechanics,
2. Examples of Quantum Systems from the point of view of Control Theory
3. Controllability of Quantum Systems (These are mathematical techniques to infer to what extent quantum systems can be controlled; This will involve some study of Lie Groups and Algebras.)
4. Observability of Quantum Systems. This topic involves the study of measurement theory in quantum mechanics
5. Mathematical Methods for the control of quantum systems. In particular Lie group decomposition techniques.  
If time permits we shall also talk about
6. Open Systems (Namely systems in which we take into account the interaction with the environment)
7. Control methods to minimize the interaction with the environment
8. Quantum feedback control