Math 7037/8037: Mathematical Control Theory

Catalog Entry. In this course we give a self-contained introductory outline of mathematical control theory for finite dimensional (ordinary differential equations) as well as for infinite dimensional systems (basic partial differential equations). Both structural properties (controllability, stabilization) as well as optimal control problems will be covered. PREREQUISITES: permission of instructor.

Course Objectives. The course will familiarize students initially with the control theory as it was vigorously developed beginning with the 50s-70s within the discipline of differential equations, also extending classical calculus of variation. It will proceed to provide a basic introduction to the control theory of more advanced dynamics such as partial differential equations with controllers acting on the boundary.

Course Material. The course will follow the book "Mathematical Control Theory", by Jerzy Zabczyk, Birkhauser, 1992, as a basic reference to be complemented by additional sources.

Course Outline. About 4 weeks on structural properties for finite dimensional linear system (controllability, observability, stability and stabilizability). About 3 weeks for structural properties for finite dimensional nonlinear systems (controllability and observability). Both the perturbation method and the global method based on Lie Brackets of vector fields will be covered. About 4 weeks about optimal control, in particular, time-optimal control and the quadratic optimal control problems, and how to find them using dynamic programming and the maximum principle approaches. Finally, about 3 weeks on infinite dimensional control theory and corresponding Riccati theory, as it applies to partial differential equations subject to control action.

Course Requirements. Course offered at both the 7000 and the 8000 level. Active class participation based on regularly assigned Home Work and presentations. 8000 level students will be introduced to some research problems.

Grading Policy. A-F grades will be given based on course requirements.