Course Syllabus for
DAUSY National Ph.D. Program in Autonomous Systems
(year 2022-23)

Course title	Introduction to Optimal Linear Quadratic Control
Scientific Discipline Sector	ING-INF/04
Hours of instruction	20 hours
CFU	2 CFU
Semester, period	Second semester, february-march 2024
Goal	The course is an introduction to Optimal Linear Quadratic Control referred also as LQ or H2 Optimal Control. The course will provide the mathematical tools to solve the problem in full generality for continuous time systems via the Algebraic Riccati Equation and the Hamiltonian dynamics associated to this optimization problem.
Syllabus	• Introduction to mathematical basics, motivations and class outline • Infinite horizon optimal control: brute force approach for scalar systems • Finite horizon optimal control: theorem and proof. Derivation of Differential Riccati Equation • Finite horizon optimal control for scalar systems: analytical derivation • Finite horizon optimal control for multivariable systems: analytical derivation via the Hamiltonian Matrix • Infinite horizon optimal control for scalar systems: analytical derivation • Infinite horizon optimal control for multivariable systems: analytical derivation via the Algebraic Riccati Equation. • Symmetric root locus for SISO systems: derivation • Symmetric root locus for SISO systems: examples • Design of optimal control weights

Bibliography	• "Optimal Control: Linear Quadratic Methods" Brian D. O. Anderson, John B. Moore, Dover Books on Engineering, 2007 • Notes from the instructor
Examination method	Final examination based on a small control design project using Matlab/Simulink