# University Of California, Berkeley
# Department of Mechanical Engineering

## ME 190M: Model Predictive Control (1 units)

### Undergraduate Elective

***Syllabus***

## CATALOG DESCRIPTION

Basics on optimization and polyhedra manipulation. Analysis and design of constrained predictive controllers for linear and nonlinear systems.

## COURSE PREREQUISITES

ME132

## TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

J.M. Maciejowski, **Predictive control with constraints**, Prentice-Hall, Pearson Education Limited, Harlow, UK, 2002, ISBN 0-201-39823-0 PPR

F. Borrelli, **Constrained Optimal Control of Linear and Hybrid Systems**, Lecture Notes in Control and Information Sciences, Springer-Verlag. Vol 290.

## COURSE OBJECTIVES

Applications ranging from the process industry to the automotive and the communications sector are making increased use of Model Predictive Control (MPC) where a fixed control law is replaced by on-line optimization performed over a receding horizon. The advantage is that MPC can deal with almost any time-varying process, constraints and specifications, limited only by the availability of real-time computational power. In the last few years we have seen tremendous progress in this interdisciplinary area where fundamentals of systems theory, computation and optimization interact. The first part of the course is an overview of basic concepts of optimization. In the second part we will show how these concepts are utilized to derive MPC algorithms and to establish their properties.

## DESIRED COURSE OUTCOMES

- Learning how to identify, formulate, and solve predictive control problems
- Learning to use modern optimization tools necessary for engineering practice
- Learning how to enforce stability and feasibility when using predictive control

## TOPICS COVERED

- Introduction to Predictive Control.
- Fundamentals of Optimization. Review of linear programming, quadratic programming
- Polyhedra, Polytopes and Simplices, Definition and Basic Manipulations.
- Optimal Control Theory and Dynamic Programming
- Predictive Control: Fundamentals, Stability and Feasibility Theory

## CLASS/LABORATORY SCHEDULE

One hour of lecture.

## CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

- Learning to use modern optimization tools necessary for engineering practice.
- Learning how to identify, formulate, and solve predictive control problems

## RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

- ability to apply knowledge of mathematics, science, and engineering
- ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- ability to identify, formulate, and solve engineering problems
- ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

## ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

- Homework assignments (20 %),
- Midterm Project (30 %),
- Final project (50 %).

## PERSON(S) WHO PREPARED THIS DESCRIPTION

Francesco Borrelli, 17 March 2009

**ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM):** MODEL PRCDT. CONTRL
**TIE CODE:** LECT
**GRADING:** Letter
**SEMESTER OFFERED:** Fall and Spring
**COURSES THAT WILL RESTRICT CREDIT:** NONE
**INSTRUCTORS:** Francesco Borrelli
**DURATION OF COURSE:** 15 Weeks
**EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK:** 3
**IS COURSE REPEATABLE FOR CREDIT?** No
**CROSSLIST:** None