课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	**高级机器人控制 Advanced Control for Robotics**
2.	**课程性质** **Compulsory/Elective**	选修课
3.	**开课单位** **Offering Dept.**	系统设计与智能制造学院 School of System Design and Intelligent Manufacturing
4.	**课程学分/学时** **Course Credit/Hours**	3 学分/48 学时 3 Credits /48 Hours
5.	**授课语言** **Teaching Language**	中文 Chinese
6.	**授课教师** **Instructor(s)**	张巍 Wei Zhang
7.	**开课学期** **Semester**	秋季 Fall
8.	**是否面向本科生开放** **Open to undergraduates or not**	是 Yes
9.	**先修要求** **Pre-requisites**	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 研究生没有要求；本科生需先修 EE368 以及 SDM364/ME424/SDM366（三选一即可）

10. 教学目标
Course Objectives

（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）
本课程主要目的是培养机器人方向的研究生数学、优化、控制与机器学习基础。教学生如何辨识、刻化、和求解机器人中的建模与优化问题。内容包括高等机器人动力学以及其与优化的关系、最优控制、模型预测控制、强化学习等。

The objective of this course is for students to develop the ability to recognize, formulate, and solve Optimization and machine learning problems within the context of robotics applications. We will consider a range of classical problems spanning dynamics, stability analysis , controller design, reinforcement learning, and show how they can be posed as constrained optimization problems. An emphasis will be placed on developing competency in control and optimization theory and on applications within robotics.

11. 教学方法
Teaching Methods

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课堂讲授，课后习题，和大作业
Lecture and projects

12. 教学内容
Course Contents
（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

Section 1	相关数学与优化背景介绍 Math and Optimization Review
Section 2	空间向量、空间力与空间动量

		Spatial Vector, forces, and Momentum
	Section 3	多刚体动力学 Multibody Dynamics
	Section 4	最优控制基础 Introduction to Optimal Control
	Section 5	模型预测控制算法 Model Predictive Control Algorithm
	Section 6	模型预测控制理论 Model Predictive Control Theory
	Section 7	强化学习原理与算法 Reinforcement Learning Theory and Algorithms
	Section 8	前沿机器人控制与学习算法 Advanced topics on robot control and learning
	Section 9	大作业项目汇报 Project Presentation

13. 课程考核
Course Assessment

（①考核形式 Form of examination；②.分数构成 grading policy；③如面向本科生开放，请注明区分内容。If the course is open to undergraduates, please indicate the difference.）

Homework (30%), Programming Assignment (20%), Midterm (25%), Final Project 25%
本科研究生同样评分标准

14. 教材及其它参考资料
Textbook and Supplementary Readings

Rigid-Body Dynamics Algorithms - Roy Featherstone
Reinforcement Learning and Optimal Control - Dimitri P. Bertsekas, 2019
A Mathematical Introduction to Robotic Manipulation - Richard M. Murray, Zexiang Li, S. Shankar Sastry