课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	**机构与机器人中的旋量代数与李群李代数** **Screw Algebra, Lie Groups and Lie Algebra in Mechanism**
2.	**课程性质** **Compulsory/Elective**	**选修** **Elective**
3.	**开课单位** **Offering Dept.**	**机械与能源工程系** **Department of Mechanical and Energy Engineering**
4.	**课程学分/学时** **Course Credit/Hours**	**3 / 48**
5.	**授课语言** **Teaching Language**	**英文 English**
6.	**授课教师** **Instructor(s)**	**戴建生** **机械系与能源工程系** **daijs@sustech.edu.cn**
7.	**开课学期** **Semester**	**春季 Spring**
8.	**是否面向本科生开放** **Open to undergraduates or not**	**否**
9.	**先修要求** **Pre-requisites**	**无，建议有线性代数、矩阵论基础** **NO, basic knowledge of Linear algebra, Matrices is recommended**

10. 教学目标
Course Objectives

This lecture will introduce screw algebra and the Lie algebra, including screws, screw parameters, screw operation and screw algebra, twists and Mozzi's instantaneous screw axis, wrenches and Poinsot's central axis theorem, analogy between instantaneous kinematics and statics, reciprocity, Lie algebras and the Lie bracket, Lie algebra representation, matrix commutator, and Jacobi identity. The lecture will teach Lie groups, including coordinate transformation and SE(3), the rotation operator and the rotation group SO(3), the Euler-Rodrigues' Formula and the exponential map on SO(3), Rodrigues' parameters, formulae and Cayley's formula, rigid body displacement in quaternions and Lie groups, and the general displacement with dual quaternions.

The lecture will give the students ability for understanding screw algebra and Lie algebra and their applications in mechanisms.

11. 教学方法
Teaching Methods

讲授
Lectures

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	Line Geometry (week 1~week 3)
Section 2	Screw algebra and the Lie algebra (week 4~week 7)

Section 3	Lie groups (week 8~week 10)
Section 4	Finite displacement screws, operators and Lie groups (week 11~week 12)
Section 5	Finite Displacement-screw operators of SE(3) and Lie Group Actions (week 13~week 14)
Section 6	Applications of Mechanisms and Robots (week 15~week 16)

13. 课程考核
Course Assessment

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score
出勤 Attendance	每月一次 once a month	5%
课堂表现 Class Performance	每月一次 once a month	5%
小测验 Quiz	无	0
课程项目 Projects	无	0
平时作业 Assignments	期中和期末各一次 Mid-term and end-of-term	90%
期中考试 Mid-Term Test	无	0
期末考试 Final Exam	无	0
期末报告 Final Presentation	无	0

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

1. 戴建生，《旋量代数与李群李代数》出版于高等教育出版社“现代数学基础”丛书，2020 年第二版/37 万字/375 页
2. 戴建生，《机构学与机器人学的几何基础与旋量代数》出版于高等教育出版社“机器人科学与技术”丛书， 2018 年再次印刷/58 万字/488 页
3. 戴建生 等，《可重构机构与可重机器人——分岔演变的运动学分析、综合及其控制》出版于高等教育出版社“机器人科学与技术”丛书，国家科学技术学术著作出版基金资助出版，2021 年/64 万字/516 页
4. C. Qiu, J.S. Dai, 2020. 《Analysis and Synthesis of Compliant Parallel Mechanisms—Screw Theory Approach》, Springer, London. ISBN: 978-3-030-48312-8