课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	设计力学 Mechanics for Design
2.	**授课院系** **Originating Department**	系统设计与智能制造学院 School of System Design and Intelligent Manufacturing
3.	**课程编号** **Course Code**	SDM283
4.	**课程学分 Credit Value**	3
5.	**课程类别** **Course Type**	专业基础课 Major Foundational Course
6.	**授课学期** **Semester**	春季 Spring
7.	**授课语言** **Teaching Language**	中英双语 English & Chinese
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师）** **Instructor(s), Affiliation& Contact** **（For team teaching, please list all instructors）**	吴元庆 系统设计与智能制造学院 Yuanqing WU School of System Design and Intelligent Manufacturing Email: wuyq@sustech.edu.cn
9.	**实验员/助教、所属学系、联系方式** **Tutor/TA(s), Contact**	
10.	**选课人数限额(可不填)** **Maximum Enrolment** **（Optional）**	

11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
	学时数 Credit Hours	32	0	32	0	64

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA102B 高等数学（下）A MA102B Calculus II A
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 NIL
14.	其它要求修读本课程的学系 Cross-listing Dept.	无 NIL

教学大纲及教学日历 SYLLABUS

本课程将基本力学概念应用于一系列结构、机构和机器元素的设计工程问题，并通过力学探索设计评估和分析的思想。课程内容包含：

◦空间运动学：定轴旋转，瞬时轴，速度，加速度，移动参考系，速度与力旋量。
◦应力分析：屈曲，细长比，疲劳，安全系数，应力状态，3D 应力元素，应力矩阵，平面应力，应力变换，平面应力的特殊情况，应变变换，破坏准则，冯 • 米塞斯准则，特雷斯卡屈服准则， 最大法向应力理论。
◦动力学：虚拟功原理，达朗贝尔原理，汉密尔顿原理，牛顿-欧拉方程，欧拉-拉格朗日方程，凯恩方程。
◦振动：简单的谐波运动，阻尼类型，阻尼弹簧质量系统的分析。 离散系统和连续系统。

参考课程：
- SUSTech MAE202: Mechanics of materials
- SUSTech ME301: Dynamics and vibration
- MIT 2.001: Mechanics of materials I
- MIT 2.003J: Dynamics and vibration

This course applies fundamental mechanics concepts to design engineering problems for a range of structures, mechanisms, and machine elements, and explores the ideas of design evaluation and analysis through mechanics. Topics include:
- 3D kinematics: rotation around a fixed axis, instantaneous axis, velocities, acceleration, moving reference frames, twists and wrenches.
- Stress analysis: Buckling, slender ratio, fatigue, safety factors, stress states, 3D stress elements, stress matrices, plane stress, stress transformations, special cases of plane stress, strain transformation, Failure criteria, Von Mises Criteria, Tresca Yield Criterion, Maximum Normal Stress Theory.
- Dynamics: Principle of virtual work, d'Alambert principle, Hamilton's principle, Newton-Euler equation, Euler-Lagrange equation, Kane's equation.
- Vibrations: Simple harmonic motion, types of dampening, analysis of damped spring-mass systems. Lumped system and continuous system.

External reference:
- SUSTech MAE202: Mechanics of materials
- SUSTech ME301: Dynamics and vibration
- MIT 2.001: Mechanics of materials I
- MIT 2.003J: Dynamics and vibration

16. 预达学习成果 Learning Outcomes

通过课程学习和实验课程，学生应该掌握以下能力：
◦以系统方式对移动坐标架、刚体和多体系统进行空间运动学一般分析。
◦使用空间运动学和对偶原理，系统地对静定的多体系统进行静态分析。

◦以系统的方式对空间变形体执行载荷分析，应力分析，应变分析和挠度分析。
◦以系统方式对多刚体系统进行动力和振动分析。
◦以系统的方式对承受空间载荷的机器组件进行失效分析和失效设计。

Through coursework and lab sessions, students should have mastered the following abilities:

- Perform in a systematic manner general 3D kinematics analysis of floating frame, rigid bodies, and multi-body systems.
- Perform in a systematic manner statics analysis of exactly determined multi-body systems using 3D kinematics and duality principle.
- Perform in a systematic manner load analysis, stress analysis, strain analysis and deflection analysis on 3D deformable body.
- Perform in a systematic manner dynamic and vibration analysis of multi-rigid-body systems.
- Perform in a systematic manner failure analysis and failure prevention design of machine components subjected to 3D loads.

17. 课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

课程安排 Course Schedule				
教学周 Week	课程标题 Lecture Title	课时 Hour	实验 Lab	课时 Hour
1	运动学：旋转和齐次变换 Kinematics: rotation & homogeneous transformations	2	迷你项目 1：简单机械臂运动学动力学 Mini project 1: Kinematics and Dynamics of a simple robot arm	2
2	运动学：速度旋量与伴随变换 Kinematics: twists & Adjoint transformation	2		2
3	静力学：力旋量与伴随变换 Statics: wrenches & co-Adjoint transformation	2		2
4	动力学：变分原理与牛顿欧拉方程 Dynamics: variational principles and Newton-Euler formulation	2		2
5	应力应变计应力应变变换 Multiaxial Stress and Strain; Stress and Strain Transformations	2	迷你项目 2：简单机械臂应力及变形分析 Mini project 2: Stress and deflection analysis of a simple robot arm	2
6	变形 Deflections	2		2
7	弯曲 Bending: Stress and Strains; Deflections	2		2
8	扭曲 Torsion; Energy Methods	2		2
9	静态失效理论 1 Static failure theory 1	2	迷你项目 3：简单机械臂失效模式与失效分析	2

10	静态失效理论 2 Static failure theory 2	2	Mini project 3: Failure modes and effects analysis of a simple robot arm	2
11	疲劳失效理论 1 Fatigue failure theory 1	2		2
12	疲劳失效理论 2 Fatigue failure theory 2	2		2
13	自然与受迫振动方程 Equation of natural and forced vibration	2	迷你项目 4：简单机械臂振动分析 Mini project 4: Vibration analysis of a simple robot arm	2
14	离散系统的振动 Vibration of lumped system	2		2
15	连续系统的振动 Vibration of continuous system	2		2
16	振动的测量 Measurement of vibration	2		2

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

参考教材 Textbook:

Hibbeler, Russell Charles. *Engineering mechanics: statics & dynamics*. Pearson Education 2015.

Hibbeler, Russell C. *Mechanics of materials*. Pearson, 2016.

Géradin, Michel, and Daniel J. Rixen. *Mechanical vibrations: theory and application to structural dynamics*. John Wiley & Sons, 2014.

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time		占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance					
课堂表现 Class Performance					
小测验 Quiz					
课程项目 Projects					
平时作业 Assignments					
期中考试 Mid-Term Test					
期末考试 Final Exam					
期末报告 Final Presentation					
其它（可根据需要改写以上评估方式） Others (The above may be modified as necessary)	迷你项目 1 Mini-project 1	1-4 周 Week 1-4	25	无 NIL	动力学模块 Dynamics module
	迷你项目 2 Mini-project 2	5-8 周 Week 5-8	25	无 NIL	材料力学模块 Strength of material module
	迷你项目 3 Mini-project 3	9-12 周 Week 9-12	25	无 NIL	失效分析模块 Failure analysis module
	迷你项目 4 Mini-project 4	13-16 周 Week 13-16	25	无 NIL	振动模块 Vibration module

20. 记分方式 GRADING SYSTEM

√ A. 十三级等级制 **Letter Grading**
☐ B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority