

## 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.	<b>课程名称 Course Title</b>	快速成型技术 Rapid Prototyping Techniques
2.	<b>授课院系 Originating Department</b>	系统设计与智能制造学院 School of System Design and Intelligent Manufacturing
3.	<b>课程编号 Course Code</b>	SDM272
4.	<b>课程学分 Credit Value</b>	3
5.	<b>课程类别 Course Type</b>	专业基础课 Major Foundational Course
6.	<b>授课学期 Semester</b>	秋季学期 Fall semester
7.	<b>授课语言 Teaching Language</b>	英文 English
8.	<b>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 &amp; Contact (For team teaching, please list all instructors)</b>	熊异, 助理教授 系统设计与智能制造学院 Yi Xiong, Assistant Professor, School of System Design and Intelligent Manufacturing xiongy3@sustech.edu.cn
9.	<b>实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact</b>	TBD
10.	<b>选课人数限额(可不填) Maximum Enrolment (Optional)</b>	50

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	16	0	64	0	80
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	CS102A 计算机程序设计基础 A CS102A Introduction to Computer Programming A				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite					
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

This course aims at providing students with the ability to utilize different advanced manufacturing methods for rapidly converting conceptual designs into prototypes and testing their functionalities. The course consists of three parts: virtual prototyping, physical prototyping, and prototype testing. More specifically, virtual prototyping includes computer-aided design and manufacturing (CAD/CAM), generative design methods, design for manufacturing. Physical prototyping includes additive manufacturing, laser cutting, molding & casting. Prototype testing includes three-dimensional scanning, geometric dimensioning and tolerancing. This course will equip students with both theoretical and practical knowledge through project-based learning. The main target group of this course is Year 2 students.

本课程主要目标是培养学生运用各种先进制造技术将概念设计快速转化为产品原型并对其功能进行测试的能力。课程内容包括三部分：虚拟成型技术、物理成型技术、原型测试技术。其中，虚拟成型技术涉及计算机辅助设计和制造（CAD/CAM）、创成式设计方法、可制造性设计等。物理成型技术涉及增材制造技术、激光切割、铸模等。原型测试涉及三维扫描、公差和配合等。该课程将通过项目引导式的新工科教育方法使学生掌握相关理论和实践知识。本课程以二年级学生为主要对象。

#### 16. 预达学习成果 Learning Outcomes

After passing the course, the student should be able to

- 1) describe and explain the product prototyping workflow and its steps.
- 2) formulate and propose complete virtual and physical prototyping solutions for implementing conceptual designs based on design needs.
- 3) create virtual models that considers the cost, manufacturability, scalability and sustainability.
- 4) create physical models by means of additive manufacturing, laser cutting, CNC machining, as well as casting and molding.
- 5) test prototypes with measurement tools including 3D scanners.

课程结束后，学生将掌握以下技能：

- 1) 描述并解释产品原型开发流程及其步骤；
- 2) 根据设计需求，能够选择和提出完整的产品虚拟和物理原型开发方案来实现概念设计；
- 3) 能综合考虑成本、可制造性、量产能力和可持续性等因素，建立虚拟原型；
- 4) 能运用增材制造、激光切割、数控加工、铸模等制造技术建立物理原型；
- 5) 通过测量工具，譬如三维扫描，测试原型产品。

#### 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.)**

Course Schedule				
Week	Lecture Title	h	Lab Practice	h
1	Lecture 1: Introduction to rapid prototyping • The concept of rapid prototyping	2	Lab 1: CAD/CAM Basics • Safety considerations & requirements • The CAD/CAM environment • Common CAD/CAM file types	4

	<ul style="list-style-type: none"> <li>The role of prototyping in the product development process</li> <li>Prototyping steps: virtual prototyping, physical prototyping, and prototype testing</li> <li>Showcase of cool prototypes</li> </ul>		<ul style="list-style-type: none"> <li>Online resources: CAD Libraries and maker communities</li> </ul>	
2			Lab 2: Project Kick-off <ul style="list-style-type: none"> <li>Presentations on selected project topics</li> <li>Discussions on tentative prototyping solutions</li> </ul>	4
3	Lecture 2: Digital Design and Manufacturing Workflow <ul style="list-style-type: none"> <li>Integrative design and manufacturing: CAD/CAE/CAM</li> <li>CNC Programming: toolpath planning, G-code</li> </ul>	2	Lab 3: CAE Basics <ul style="list-style-type: none"> <li>Introduction to structural analysis software</li> </ul>	4
4			Lab 4: Fused Deposition Modelling <ul style="list-style-type: none"> <li>Introduction to the FDM process and materials</li> <li>Introduction to the FDM machine and software</li> <li>Manufacturing practice</li> </ul>	4
5	Lecture 3: Generative Design Basics <ul style="list-style-type: none"> <li>Motivations of generative design</li> <li>The definition of generative design</li> <li>Methods and tools for generative design</li> <li>Cases for generative design</li> <li>Realization of products by generative design</li> </ul>	2	Lab 5: Generative Design Practice <ul style="list-style-type: none"> <li>Introduction to generative design software</li> <li>Design practice</li> </ul>	4
6			Lab 6: Project Midterm Review <ul style="list-style-type: none"> <li>Presentations on selected project topics</li> <li>Discussions on tentative prototyping solutions</li> </ul>	4
7	Lecture 4: From Virtual Prototyping to Physical Prototyping <ul style="list-style-type: none"> <li>Design for Manufacturing</li> <li>Motivation of design for manufacturing</li> <li>Definition of design for manufacturing</li> <li>Design guidelines for manufacturing</li> <li>Design cases with design for manufacturing</li> <li>Design for Sustainability</li> <li>Sustainable design principles</li> <li>Aspects of environmentally sustainable design</li> <li>LCA and product life</li> </ul>	2	Lab 7: Laser Cutting <ul style="list-style-type: none"> <li>Introduction to the laser cutting machine and software</li> <li>Manufacturing practice</li> </ul>	4
8			Lab 8: Stereolithography <ul style="list-style-type: none"> <li>Introduction to the SLA process and</li> </ul>	4

			<ul style="list-style-type: none"> <li>materials</li> <li>• Introduction to the SLA machine and software</li> <li>• Manufacturing practice</li> </ul>	
9	<p>Lecture 5: Additive Manufacturing Basics</p> <ul style="list-style-type: none"> <li>• Overview of seven AM processes</li> <li>• AM workflow</li> <li>• Design for Additive Manufacturing</li> </ul>	2	<p>Lab 9: Lightweight Structure Design and Fabrication</p> <ul style="list-style-type: none"> <li>• Design of lightweight structure in software</li> <li>• Manufacturing practice</li> </ul>	4
10			<p>Lab 10: Molding and Casting</p> <ul style="list-style-type: none"> <li>• Introduction to the molding and casting processes</li> <li>• Manufacturing practice</li> </ul>	4
11	<p>Lecture 6: Other Physical Prototyping Methods</p> <ul style="list-style-type: none"> <li>• Prototyping with wood</li> <li>• Prototyping with foamcore</li> <li>• Prototyping with polystyrene foam</li> <li>• Prototyping with thermoplastic sheet</li> <li>• Prototyping with polyurethane</li> </ul>	2	<p>Lab 11: Other Physical Prototyping Methods</p> <ul style="list-style-type: none"> <li>• Introduction to lab CNC machines</li> <li>• Manufacturing practice</li> </ul>	4
12			<p>Lab 12: Joining and Assembly</p> <ul style="list-style-type: none"> <li>• Introduction to typical joining methods</li> <li>• Practice</li> </ul>	4
13	<p>Lecture 7: Reverse Engineering and 3D Scanning</p> <ul style="list-style-type: none"> <li>• The workflow of reverse engineering</li> <li>• 3D Scanning and its principles</li> <li>• Geometric dimensioning and tolerancing</li> </ul>	2	<p>Lab 13: Laser Scanning</p> <ul style="list-style-type: none"> <li>• Introduction to 3D laser scanners</li> <li>• Reconstruction of CAD models</li> </ul>	4
14			<p>Lab 14: Project Implementation (I)</p> <ul style="list-style-type: none"> <li>• Manufacturing parts for projects</li> </ul>	4
15	<p>Lecture 8: From Prototyping to Production</p> <ul style="list-style-type: none"> <li>• The iterative process of prototyping</li> <li>• Production methods for replacing prototyping methods</li> <li>• Manufacturing plans</li> </ul>	2	<p>Lab 15: Project Implementation (II)</p> <ul style="list-style-type: none"> <li>• Assembling parts for projects</li> </ul>	4
16			<p>Lab 16: Project Final Review</p> <ul style="list-style-type: none"> <li>• Group presentations</li> <li>• Wrapping up of the course</li> </ul>	4

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

1. Gibson, I., Rosen, D.W. and Stucker, B., 2014. Additive manufacturing technologies. New York: Springer.
2. Hallgrímsson, B., 2012. Prototyping and modelmaking for product design. London: Laurence King

19. 记分方式 GRADING SYSTEM

Type of Assessment	Assessment Time	% of final score	Penalty	Notes
出勤 Attendance	课程审批 (通过/不通过)	Pass/Fail Grading	NIL	To assess a student's individual work ethics and collaborative team works.
<b>REVIEW AND APPROVAL</b>				
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				
课程项目 Projects	Week 1-16	70	NIL	Group presentation, group score and individual score. Semester-long project: a prototype making and functionality.
平时作业 Assignments	Week 1-16	20	NIL	To assess students' grasp of coursework knowledge.