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**	**综合系统设计入门 Introduction to Integrative System 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 (SDIM)
3.	**课程编号 Course Code**	SDM101
4.	**课程学分 Credit Value**	4
5.	**课程类别 Course Type**	通识通修选修课程 General Education (GE) Elective Courses
6.	**授课学期 Semester**	夏季 Summer
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）**	吴景深(Jingshen Wu) 系统设计与智能制造学院 (SDIM) 吴元庆 (Yuanqing Wu) 系统设计与智能制造学院 (SDIM) Fred HAN 系统设计与智能制造学院 (SDIM) 王珂 (Ke Wang) 系统设计与智能制造学院 (SDIM) 李泽湘 (Zexiang Li) 系统设计与智能制造学院 (SDIM)
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	待公布 To be announced
10.	**选课人数限额(可不填) Maximum Enrolment （Optional）**	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	32	64		112

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无 NIL
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

15. 教学目标 Course Objectives

The summer course will introduce various design concepts and approaches for performing engineering design and prototyping through a project from real-world. Students will learn how to perform user, product and market survey and make product definition. As a blended, project-based course, students will also learn how to select between different engineering tools for manufacturing and assembly of a functional prototype, and how to acquire new tools independently in the future to meet unexpected challenges. Students are required to complete project in team in a studio environment where students will develop an understanding of shared engineering practice.

The summer course is aimed at enabling students to make the choices necessary to successfully complete an engineering design. By conducting an experiment, doing a rough estimation, performing a detailed calculation based on mathematical models, or creating a computer simulation, students will select the best part from a catalog, choose an appropriate material, determine the effect of certain influences on their design.

For Year-1 students only.

16. 预达学习成果 Learning Outcomes

By the end of the course, all students will be familiar with

- User Research Skills
  - ✓ Empathized approach to user's issues
  - ✓ Design techniques of effective Survey questionnaires
  - ✓ Stakeholder Interview techniques
  - ✓ Analysis techniques of investigation results
- Market & Comparable Product Research Skills
  - ✓ Market research techniques
  - ✓ Analysis techniques of comparable products
  - ✓ Product proposition skills
- Constructing Product Definition Methodology

- ✓ Project Brief writing techniques

- Concept Exploration Skills
  - ✓ Concept brainstorm techniques
  - ✓ User-centric product concept development skills
  - ✓ Collaboration techniques of multidisciplinary engineering
- Concept Implementation Skills
  - ✓ Develop engineering design specification for a product based on initial concepts.
  - ✓ Develop design alternatives and conduct design evaluation based on a design specification.
  - ✓ Communicate effectively via engineering drawings and design presentation.
  - ✓ Conduct detailed component design to meet the engineering specification of parts or assemblies.
  - ✓ Select appropriate materials and manufacturing processes for engineering parts based on design requirements.
- Build, Test and Prototyping Skills
  - ✓ Understand the uses of prototypes.
  - ✓ Physical and analytic prototypes.
  - ✓ Virtual prototyping
  - ✓ Traditional prototyping methods.
  - ✓ Rapid prototyping methods including 3D printing.
- Economic Analysis Skills
  - ✓ Build financial model for the project and expected profit
  - ✓ Perform sensitivity analysis to understand key assumptions of the model
  - ✓ Use sensitivity analysis to understand project trade-offs
  - ✓ Consider the influence of qualitative factors on project success
- Project Management Skills
  - ✓ Team building and development
  - ✓ Project planning and coordination
  - ✓ Project assessment and review

Students major in material engineering are expected to have

- good knowledge on kinds of materials, properties of materials, processing and manufacturing processes of materials;
- a clear understanding on the steps and methods required to properly select a material and ability to use materials selection charts, decision matrices, computer-aided material selections to select materials;
- ability to communicate effectively with and understand the material needs from teammates;
- understanding of the impact of materials selection on issues such as economics, business, environment, health and safety, sustainability, and societal context;
- clear understanding of professional and ethical responsibilities in materials selection;

Students major in mechanical engineering are expected to have

- understanding of engineering design process and knowledge of typical manufacturing process;
- ability to use feature-based CAD modelling software to design and assemble parts from sketches;
- working knowledge of manufacturing processes for rapid-prototyping;
- working knowledge of mechanisms and transmission involved in product mechanical design;
- understanding of the impact of mechanical design on manufacturability and assemblability;

Students major in electrical and electronic engineering are expected to have

- basic knowledge of electric circuits, analog electronics and digital logic; working knowledge of electric motor and motor control circuits
- ability to simulate electric circuits using MULTISIM software
- basic knowledge of principles and models of commonly seen sensors; ability to program a microcontroller to control products and devices

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	Hour	In-class		Out of class	Hours
		Lecture Title	Language	Tutorial and Lab in Makerspace	
1	1	Introduction of Design, Design Thinking	• English	Market survey	8
	1	The Role of the Materials Selection in Design	• English	Product prototyping	4
	1	User Research and Discovery of User Insights	• English	Product Assembly	4
2	1	Introduction to Design of Robots and its Subsystems	• English	Product testing	4
	1	Market and Comparable Product Research	• English	Product validation	2
	1	Sketching and Engineering Drawing	• English	User feedback survey	2
3	1	Material Kinds, Properties, Ranking and Costs	• English	Bite-size Lab 1 Product comparison of a typical consumer electronic product	12
	1	Resource Management	• English		

	1	Engineering Design and Manufacturing	• English	(Roomba, e.g.)		
4	1	Motors and Electric and Electrical Circuits	• English	Bite-size Lab 2 Design/redesign of an existing product in CAD modeling software, and verification using 3d printer	20	
	1	Mechanism and transmission in product design	• English			
	1	Material Testing Methods and Data Analysis	• English	Bite-size Lab 3 Creative mechanism design to enhance functionality of an existing product, and verification using 3d printer	18	
5	1	Sensor and Embedded Systems	• English			
	1	Design for Manufacturing and Assembly	• English	Bite-size Lab 4 Complete dissection and re-assembly of Roomba	12	
6	1	Microcontroller Programming	• English			
	1	3D Printing Technology – Programming and Materials	• English	Bite-size Lab 5 Mini stm32 project	10	

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

Textbook:

Ulrich, Karl T. *Product design and development*. Tata McGraw-Hill Education, 2003.

Supplementary readings:

Madsen, David A., and David P. Madsen. *Engineering drawing and design*. Nelson Education, 2016.

Ashby Michael F. *Materials Selection in Mechanical Design* Elsevier 2011.

Scherz, Paul. *Practical electronics for inventors*. McGraw-Hill, Inc., 2006.

Boothroyd, Geoffrey, Peter Dewhurst, and Winston A. Knight. *Product Design for Manufacture and Assembly, revised and expanded*. CRC press, 2001.

Carryer, J. Edward, R. Matthew Ohline, and Thomas William Kenny. *Introduction to mechatronic design*. Prentice Hall, 2011.

Gay, Warren. *Beginning STM32: Developing with FreeRTOS, libopencm3 and GCC*. Apress, 2018.

课程评估 ASSESSMENT

19.

Type of Assessment	Assessment Time	% of final score	Penalty	Notes
Product Research Presentation	End of the 1st week	5	NIL	To assess students' sense of the real-world context & context learning ability and design thinking mind-set
Concept	End of the 2nd week	5	NIL	To assess students' design and

&Sharing Presentation				creativity ability & communication skills
Performance of bite-size labs	End of each lab	10	NIL	To assess students' achievement in domain knowledge
Weekly individual Presentation	5-10 min presentation on Friday of each week	15	NIL	to assess a student's self-directed learning ability, hands-on skill and intrinsic motivation.
Quiz	Every day given by professors	5	NIL	Teachers give quiz to stimulate the students' self-directed learning and assess the learning outcomes of the students.
Final Team Presentation	Last week of the semester	10	NIL	To assess students' communication, teaming and collaboration skills
Team Performance	In process evaluation by professors	15	NIL	To assess students' achievement in disciplinary integration; hands-on operation; collaboration;
Resource Management Performance	In process evaluation and at the end of the course	5	NIL	To assess students' sense of the real-world context & management skills.
Teammate Evaluation by anonymous vote	Every other week on Friday	10	NIL	To assess individual's team spirit, accountability & intrinsic motivation.
Final Competition on stage	Last week of the semester	20	NIL	To assess the overall achievement of the teams

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