

## 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>	系统工程基础 Fundamentals of System Engineering
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>	SDM224
4.	<b>课程学分 Credit Value</b>	3
5.	<b>课程类别 Course Type</b>	专业核心课 Core Course
6.	<b>授课学期 Semester</b>	秋季学期 Fall semester
7.	<b>授课语言 Teaching Language</b>	中文和英文 Chinese-English bilingual
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>	王振坤 系统设计与智能制造学院 Zhenkun Wang School of System Design and Intelligent Manufacturing Email: wangzk3@sustech.edu.cn
9.	<b>实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact</b>	待定 To be confirm
10.	<b>选课人数限额(可不填) Maximum Enrolment (Optional)</b>	待定 To be confirm

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	无 No				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 No				
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 No				

### 教学大纲及教学日历 SYLLABUS

**SDM224 “系统工程基础”** 课程涉及系统组织建立和运行管理中的主要概念和技术，旨在培养学生运用系统思想与方法来处理复杂综合性问题的能力。学生将首先了解系统的分类与系统工程的发展史，掌握系统工程的一般原则与方法论，并熟悉系统工程的作用及应用领域。在系统的开发和维护过程中，都离不开系统的设计。而系统设计是在系统分析的基础上进行的。因此本课程还将介绍系统分析与设计的基本程序与步骤，并讲授一些常用的系统评价方法，如基本效益法，聚类分析法。项目管理是系统开发中必不可少的要素，因此本课程还将介绍项目管理的基本步骤，实施技巧和预防措施。同时学生还将学习系统建模与仿真中常用技术，如数学仿真和计算机仿真等。系统评价与预测能够为系统的规划设计和运营管理提供科学依据。本课程将介绍系统评价与预测中常用的方法。除此之外，学生还将学习到系统决策与优化相关的知识。在当代，随着系统逐渐地复杂化、大规模化和多目标化，传统的优化技术越来越不堪重负。因此本课程还将介绍一些先进的智能优化技术与决策技术。

This course, **SDM224 “Fundamentals of Systems Engineering”**, introduces the main concepts and techniques in the establishment and operation of a system. It aims to develop students' ability to use system thoughts and methods to address complex problems. Students will first learn the classification of systems and the development of system engineering, study the main principles and methodologies of system engineering, and understand the application value of the system engineering. System design exists in each stage of the development and maintenance of a system, while the system analysis is the basis of system design. Therefore, this course will also introduce the basic procedures of system analysis and design and presents some commonly used system evaluation methods, such as the basic benefit method and the cluster analysis method. Project management is an essential element in the development of a system, and the basic steps, implementation skills and precautions in the project management will be introduced in this course. Meanwhile, students will also learn the widely used techniques in system modeling and simulation, such as the mathematical simulation and the computer simulation. System evaluation and prediction can provide a scientific basis for the planning and management of a system. This course will introduce the commonly used methods in the system evaluation and prediction. In addition, students will also learn the knowledge about the system decision-making and optimization. Currently, as the system is gradually becoming more complex, large-scale, and multi-objective, traditional optimization techniques are becoming increasingly overwhelmed. Therefore, this course will also introduce some advanced intelligent optimization and decision-making techniques.

#### 16. 预达学习成果 Learning Outcomes

到本课程结束时,学生应当掌握以下能力:  
熟悉系统工程的一般原理和方法论。  
熟悉系统设计和优化的基本流程。  
熟悉项目管理,能够在系统或项目开发中进行成功的项目管理。  
能够进行系统建模和模拟。

熟悉常见的决策和优化技能。  
能够使用通用的智能优化算法。  
能够利用所学的预测、评估、优化和决策技能开发并管理系统。

By the end of this course, students should have mastered the following abilities:

- Be familiar with the general principles and methodology of the system engineering.
- Be familiar with the basic procedures of the system design and optimization.
- Be familiar with project management and be able to conduct a successful project management in a system or project development.
- Be about to conduct a system modelling and simulation.
- Be familiar with the common decision-making and optimization skills
- Be able to use generally used intelligent optimization algorithms
- Be able to develop a system and manage it using the learned prediction, evaluation, optimization and decision-making skills.

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	In-class		Out of class	
	Lecture Title	Hour	Tutorial / Lab Practice	Hour
1	系统工程(SE)导论: 1.课程介绍 2.SE 的定义 3.SE 的历史 Introduction to System Engineering (SE): 1, course introduction 2, the definition of SE 3, the history of SE	2	1.以 SE 的方式快速阅读一本书 2.MATLAB 基础编程原理训练 1, Quickly read a book in the SE way 2, Training of MATLAB-Basic coding principles	2
2	概念到系统: 1.系统的分类 2.系统的特征 3.系统的描述 Concept to System: 1, Classifications of systems 2, Characteristics of systems 3, Description of a system	2	1.你认为自己在成为 SE 工程师方面还需要改进什么? 2.MATLAB 基础函数训练 1, What do think you can be improved towards a SE engineer? 2, Training of MATLAB-Basic functions	2
3	系统生命周期: 1.系统生命周期的四个阶段 2.采购阶段和使用阶段的活动 3.系统开发方法 System Life Cycle: 1, the four phases of the system life cycle 2, Activities in Acquisition phase and Utilization phase 3, System developmental approaches	2	1.主项目的目标 2.主项目的进度安排 3.MATLAB 统计与分析训练 1, The objectives of the main project 2, The schedule of the main project 2, Training of MATLAB-Statistics and analysis	2
4	SE 主题: 1.自顶向下方法 2.需求工程 3.生命周期关注	2	1.在主项目中实践自顶向下方法 2.描述主项目中与生命周期相关的注意事项	2

	<p>4.系统优化与平衡 SE topics: 1, Top-down approach 2, Requirement engineering 3, Life-cycle focus 4, System optimization and balance</p>		<p>1, The top-down approach practice in the main project 2, Describe the concerns about the life-cycle in the main project</p>	
5	<p>需求工程: 1.需求生成 2.需求验证 3.需求管理 Requirement engineering: 1, Requirement generation 2, Requirement validation 3, Requirement management</p>	2	<p>1.收集主项目需求 2.确定系统范围 3.构建主项目的跟踪矩阵 1, Collect the requirements of the main project 2, Define the scope of the system 3, Build trace matrix of the main project</p>	2
6	<p>概念设计: 1.确定业务需求和要求 2.确定利益相关者需求和要求 3.确定系统需求 Concept Design: 1, Define Business Needs and Requirements 2, Define Stakeholder Needs and Requirements 3, Define System Requirements</p>	2	<p>1.进行系统综合 2.起草系统需求规格说明书(SyRS) 1, conduct the system synthesis 2, draft the SyRS</p>	2
7	<p>概念设计: 1.完善业务需求和要求 2.建立需求框架 3.需求分析和分配 Concept Design: 1, Finalize Business Needs and Requirements 2, Establish Requirements Framework 3, Requirements Analysis and Allocation</p>	2	<p>1.进行需求评审 2.完善 SyRS 1, conduct Requirement review 2, refine the SyRS</p>	2
8	<p>SyRS 汇报演示 Presentation on SyRS</p>	2	<p>进一步完善 SyRS Further refine the SyRS</p>	2
9	<p>其他 SE 活动: 1.详细设计 2.建造和生产 3.使用阶段和退役 Other SE Activities: 1, Detailed Design 2, Construction and Production 3, Utilization Phase and Retirement</p>	2	<p>1.系统开发计划及详细进度安排 2.渐进式评审计划 3.验证和确认(V&amp;V)计划 1, Development plan of the system with detailed schedule 2, Progressively review plan 3, V&amp;V plan</p>	2
10	<p>项目管理 1.什么是项目管理 2.项目计划 3.沟通技巧和领导力 4.时间管理风险控制 5.项目评审 Project Management</p>	2	<p>1.风险分析 2.进度评审报告 3.测试和验证报告 1, Risk analysis 2, Progress review report 3, Test and validation report</p>	2

	<p>1, what is project management 2, project planning 3, communication skills and leadership 4, time management risk control 5, project review</p>			
11	<p>系统预测和评估 1. 定量和定性预测 2. 系统评估概述 3. 回归分析预测 4. 层次综合评估 System Predication and Evaluation 1, quantitative and qualitative prediction 2, the overview of system evaluation 3, regression analysis prediction 6, hierarchical comprehensive evaluation</p>	2	<p>1. 进度评审报告 2. 测试和验证报告 3. 回归分析预测实践 1, Progress review report 2, Test and validation report 3, Practices of regression analysis prediction</p>	2
12	<p>优化和决策 1. 系统优化概述 2. 线性规划 Optimization and Decision-making 1, the overview of system optimization 2, linear programming</p>	2	<p>1. 进度评审报告 2. 测试和验证报告 3. 线性规划方法实践 1, Progress review report 2, Test and validation report 3, Practices of LP methods</p>	2
13	<p>优化和决策 1. 整数规划 2. 切割平面法 3. 分支定界法 Optimization and Decision-making 1, integer programming 2, cutting edge method 3, branch and bound method</p>	2	<p>1. 进度评审报告 2. 测试和验证报告 3. 整数规划方法实践 1, Progress review report 2, Test and validation report 3, Practices of LIP methods</p>	2
14	<p>智能优化算法 1. 启发式算法 Intelligent optimization Algorithms 1, heuristic algorithms</p>	2	<p>1. 进度评审报告 2. 测试和验证报告 3. 启发式算法实践 1, Progress review report 2, Test and validation report 3, Practices of heuristic algorithms</p>	2
15	<p>课程回顾 Review of the course</p>	2	<p>1. 进度评审报告 2. 验证和确认报告 3. 修订 SyRS 1, Progress review report 2, Validation and verification report 3, Modified SyRS</p>	2
16	<p>最终汇报演示 Final presentation</p>		<p>用户反馈 最终报告 User feedback Final report</p>	2

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

**Textbook:**

R.I. Faulconbridge and M.J. Ryan, "Introduction to Systems Engineering", Argos Press, Canberra, 2015.  
严广乐, 系统工程导论, 清华大学出版社, 2015。

**课程评估 ASSESSMENT**

19.

Type of Assessment	Assessment Time	% of final score	Penalty	Notes
<b>Class Performance</b>	Week 1-16	28	NIL	To assess students' grasp of coursework knowledge.
<b>Assignments</b>	Week 1-16	28	NIL	Lab assignments
<b>Mid-term Presentation</b>	Week 8	8	NIL	Presentation about the SyRS
<b>Final Presentation</b>	Week 16	21	NIL	Presentation about the design and management of a system
<b>Final Report</b>	Week 16	15	NIL	Semester-long project

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**