

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	金属材料 A Physical Metallurgy A
2.	授课院系 Originating Department	材料科学与工程系 Department of Materials Science and Engineering
3.	课程编号 Course Code	MSE319
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业核心课 Major Core Courses
6.	授课学期 Semester	秋季 Fall
7.	授课语言 Teaching Language	英文 English
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)	黎长建 助理教授 Dr.Li Changjian, Assistant Professor Department of Materials Science and Engineering 0755-88010513 licj@sustech.edu.cn
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)	

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	48				48
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MSE001 材料科学与工程基础 Fundamentals of Materials Science and Engineering MSE002 材料科学与工程基础实验 Experiments for Fundamentals of Materials Science and Engineering				
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.					

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

金属学是材料科学与工程系学生的一门选修课，其目的是使学生掌握金属材料的基础知识。了解金属及合金的成分、组织、结构与性能之间的相互关系及其变化规律。掌握常用材料的组织结构的形成与变化规律，同成分、外界条件之间的关系，及其对材料性能的影响。了解常用金属材料的铸造、加工和热处理工艺，以及其在工业中的应用。并对金属材料的前沿研究有初步的认识。

Physical Metallurgy A is an elective course for students in Department of Materials Science and Engineering, aiming to instruct the basic knowledge of metal materials to students. Understand the relationship among the composition, structure and properties of metals and alloys. Understand the manufacturing, deformation and heat treatment processes in conventional metallic materials and their applications in industry. To have a preliminary understanding of the frontier research of metallic materials.

16. 预达学习成果 Learning Outcomes

通过本课程的学习，应使学生掌握金属及合金的成分、组织、结构与性能之间的相互关系及其变化规律；掌握和金属相关的热力学、扩散、界面、金属的凝固、扩散型相变以及非扩散型相变的知识。了解工业中常用的结构材料如钢、铝合金、铜合金、钛合金等铸造、成形和热处理方法。同时了解金属领域出现的新材料如金属玻璃、形状记忆合金、高熵合金的研究状况。使学生能够运用所学的理论对一些典型的实际工程问题进行大致的分析。

Through the study of this course, students will master the relationship and change rules among the composition, structure and properties of metals and alloys. Master the knowledge of thermodynamics, diffusion, interface, metal solidification, diffusional transformation and diffusionless transformation in metal materials. Understand the manufacturing and heat treatment methods of common structural materials such as steel, aluminium alloys, copper alloys and titanium alloys. Meanwhile understand the research progress of some new metal materials such as metallic glass, shape memory alloys and high entropy alloys. After finishing the course, students are expected to use the learned theories to briefly analyse some typical practical engineering problems.

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.)

1. 金属晶体学与微结构 Metal crystallography and microstructure (6 课时) (6 Credit hours)
 - 金属基本特征概述 Metallic bonding key characteristics for metals.
 - 晶体结构、缺陷 Crystallography, defects
 - 位错、应力场、应力势能 Dislocations, stress field and energy
 - 晶体显微结构 Observation of the microstructures
 - 金属冶炼 Metal extraction
2. 相图 (6 课时) Phase Diagrams (9 Credit hours)
 - 平衡 Equilibrium
 - 单组元系统 Single Component Systems
 - 二元溶液 Binary Solutions
 - 非均匀系统中的平衡 Equilibrium in Heterogeneous Systems
 - 二元相图 Binary Phase Diagrams
 - 界面对平衡的影响 The Influence of Interfaces on Equilibrium
 - 三元平衡 Ternary Equilibrium
 - 二元溶液的其他热力学关系 Additional Thermodynamic Relationship for Binary Solutions
 - 相变动力学 The Kinetics of Phase Transformations
3. 相变 (6 课时) Phase transformation (6 Credit hours)
 - 固相中的均匀形核、长大 Homogeneous Nucleation, growth in Solids
 - 综合转变动力学: TTT 图 Overall Transformation Kinetics-TTT Diagrams
 - 时效强化合金中的脱溶 Precipitation in Age-Hardening Alloys
 - 无扩散相变概述 introduction to Diffusionless Transformations
 - 马氏体晶体学 Martensite Crystallography
 - 马氏体形核理论 Theories of Martensite Nucleation
 - 马氏体长大 Martensite Growth
4. 铁碳合金热处理工艺 (6 课时) Fe-C alloy system and heat treatment(6 Credit hours)
 - 铁碳合金相图, 分类应用 Phase diagram, classification of Fe-C alloy
 - 热处理基本原理 Principles of heat treatment
 - 钢的整体热处理 Bulk heat treatment
 - 钢的表面热处理 Surface heat treatment
5. 微观机理复习 (3 课时)
6. 铸造成形基础与工艺 (6 课时) Casting
 - 铸造成形概述 Introduction to casting
 - 合金的流动性 fluid flow process
 - 合金的收缩性 Shrinkage during casting process
 - 缩孔与缩松 porosity and shrinkage
 - 铸造应力 casting stress
7. 金属塑性成形基础与工艺 (6 课时) metal plastic forming
 - 塑性成形概述 introduction
 - 金属的塑性变形 metal plastic deformation
 - 冷变形与热变形 cold work and hard work
 - 金属的可锻性 Metal forgeability
 - 自由锻 free forging
 - 模锻与胎模锻 Die forging and
 - 分离工序 Separation process
 - 变形工序 forging process
 - 轧制、挤压和拉拔 Rolling, Extrusion and drawing
8. 有色金属合金 (6 课时) An introduction to selected non-ferrous alloy systems (6 Credit hours)
 - 铝及铝合金 Al and Al alloys
 - 钛及钛合金 Ti and Ti alloys
 - 铜及铜合金 Cu and Cu alloys
 - 特种合金及合金研究前沿 Special alloys and frontiers of alloy research
9. 金属工艺学复习、课程项目 (3 课时)

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

1. Physical Metallurgy, 4th Ed., R.W. Cahn P. Haasen (Editors), North Holland, 1996, Amsterdam.
2. 金属学与热处理(第二版), 崔忠圻, 覃耀春 机械工业出版社, 2007
3. 金属工艺学(第3版), 罗继相, 王志海主编, 武汉理工大学出版社, 2016
4. 金属学原理, 余永宁, 冶金工业出版社, 2000, 北京

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		10		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		30		
平时作业 Assignments		20		
期中考试 Mid-Term Test				
期末考试 Final Exam		40		
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)				

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