《工程材料及成型技术》本科课程教学大纲

一、课程基本信息

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| 课程名称 | （中文）工程材料及成型技术（英语） |
| （英文）Engineering Materials and Forming Technology |
| 课程代码 | 2080394 | 课程学分 | 64 |
| 课程学时  | 4 | 理论学时 | 48 | 实践学时 | 16 |
| 开课学院 | 机电学院 | 适用专业与年级 | 机械设计制造及其自动化（中外合作办学）专业，一年级 |
| 课程类别与性质 | 专业基础必修课 | 考核方式 | 考查 |
| 选用教材 | ChenZhaoXia: Mechanical Engineering Materials. Southwest Jiaotong University Press. 2016 | 是否为马工程教材 | 否 |
| 先修课程 | 机械制图2080066（3）、工程化学2080470（2）、材料力学2080169（3） |
| 课程简介 | "Engineering Materials and Forming Technology" is a compulsory technical basic course for mechanical majors. Through this course, students can obtain the structure, performance, application and relationship of common engineering materials, especially metal materials, knowledge of steel heat treatment concepts, various blank forming methods and features, process principles and basics, law and other knowledge. On the basis of mastering the basic theory and basic knowledge of engineering materials, the students have the preliminary ability to properly select materials and heat treatment processes for parts, can analyze the requirements of structural design of parts in combination with material forming methods and processes, can select method of blank design, blank forming and predict molding quality, and lay the necessary foundation for the subsequent courses and work in mechanical design and manufacturing. The focus of this course is on the phase diagram of iron-carbon alloys, the heat treatment of steel and the thermal processing of steel. The key engineering materials are carbon steel and alloy steel. On the basis of learning theoretical knowledge and experimental operation, students can improve their ability to select materials and materials. |
| 选课建议与学习要求 | "Mechanical Engineering Materials and Molding Technology" is an examination course for mechanism majors (Sino-US cooperation). It is a professional basic course and requires a certain mechanical drawing foundation and engineering mechanics foundation. |
| 大纲编写人 | C:\Users\fanli\AppData\Local\Temp\1646223023(1).png 高强（签名） | 制/修订时间 | 2025年2月 |
| 专业负责人 | （签名） | 审定时间 | 2025年2月 |
| 学院负责人 | （签名） | 批准时间 | 2025年2月 |

二、课程目标与毕业要求

（一）课程目标

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| 类型 | 序号 | 内容 |
| 知识目标 | 1 | 理解材料的成分、组织、性能之间的关系，材料强化和主要成型方法的工艺特点 |
| 2 | 能够运用工程材料及成型技术的知识，进行产品结构设计和优化，满足航空机械维修的特定需求 |
| 技能目标 | 3 | 具有选用工程材料、选择毛坯加工方法、进行材料成型工艺设计与分析的能力 |
| 4 | 具有查阅和运用有关标准、手册等资料进行零件选材及分析的能力 |
| 素养目标(含课程思政目标) | 5 | 培养自我学习的意识与能力，具备在相关领域跟踪、发展新理论、新知识及新技术的能力 |
| 6 | 能够使用适合的工具来搜集信息，并对信息加以分析、鉴别、判断与整合 |

（二）课程支撑的毕业要求

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| 2专业能力：通过学习机械设计制造及其自动化航空维修管理专业方向必需的理论知识与专业技能，具备良好的人文素养、职业道德和创新意识，精益求精的工匠精神，较强的就业创业能力和可持续发展的能力。2-2机械设计能力：能够运用工程材料及成型技术、机械设计原理和工程知识，进行产品结构设计和优化，满足航空机械维修的特定需求。 |
| 4自主学习：能根据环境需要确定自己的学习目标，并主动地通过搜集信息、分析信息、讨论、实践、质疑、创造等方法来实现学习目标。4-2能搜集、获取达到目标所需要的学习资源，实施学习计划、反思学习计划、持续改进，达到学习目标。 |
| 6协同创新：同群体保持良好的合作关系，做集体中的积极成员，M善于自我管理和团队管理；善于从多个维度思考问题，利用自己的知识与实践来提出新设想。6-3能用创新的方法或者多种方法解决复杂问题或真实问题。 |
| 7信息应用：具备一定的信息素养，并能在工作中应用信息技术和工具解决问题。7-2能够使用适合的工具来搜集信息，并对信息加以分析、鉴别、判断与整合。 |

（三）毕业要求与课程目标的关系

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| --- | --- | --- | --- | --- |
| 毕业要求 | 指标点 | 支撑度 | 课程目标 | 对指标点的贡献度 |
| 2专业能力 | 2-2 | H | 1理解材料的成分、组织、性能之间的关系，材料强化和主要成型方法的工艺特点 | 60% |
| 2能够运用工程材料及成型技术的知识，进行产品结构设计和优化，满足航空机械维修的特定需求 | 40% |
| 4自主学习 | 4-2 | L | 4具有查阅和运用有关标准、手册等资料进行零件选材及分析的能力 | 50% |
| 5培养自我学习的意识与能力，具备在相关领域跟踪、发展新理论、新知识及新技术的能力 | 50% |
| 6协同创新 | 6-3 | M | 3具有选用工程材料、选择毛坯加工方法、进行材料成型工艺设计与分析的能力 | 100% |
| 7信息应用 | 7-2 | M | 6能够使用适合的工具来搜集信息，并对信息加以分析、鉴别、判断与整合 | 100% |

三、课程内容与教学设计

（一）各教学单元预期学习成果与教学内容

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| **Unit 1 Properties and organization of metallic materials****Knowledge point**1. Development and classification of materials.2. The main performance indicators of the material.3. The crystal structure of the metal and the defects of the crystal, the concept and process of crystallization;4. Composition and phase of iron-carbon alloy; analysis of partial phase diagram of iron-carbon alloy steel, relationship between composition, structure and properties of iron-carbon alloy, application of phase diagram of iron-carbon alloy.**Skill requirements**1. Master the main performance indicators of materials and be able to master the classification of materials;2. Can understand the iron-carbon phase diagram and understand the relationship between the composition and structure of the material;3. The iron carbon phase diagram can be applied to the heat treatment of steel.**Teaching difficulties**1. Iron carbon phase diagram;2. Master and familiar with the teaching skills;3. Flip the psychological barriers in the classroom. |
| **Unit 2 Heat treatment and surface strengthening technology of steel****Knowledge point**1. The structural transformation of steel during heating and cooling, and the isothermal continuous transformation curve of supercooled austenite;2. The purpose, process and application of annealing, normalizing, quenching and tempering of steel; hardenability and its influencing factors;3. Surface quenching and chemical heat treatment of steel.**Skill requirements**1. Can understand the basic knowledge of heat treatment; the correct choice of the basic method of heat treatment of steel;2. Ability to select and design the heat treatment process.**Teaching difficulties**1. The law of microstructure change of quenching and tempering; the strengthening mechanism of surface heat treatment;2. Teamwork and self-learning habits.3. Master the teaching skills.4. The understanding and application of the course management method |
| **Unit 3 Steel materials and non-ferrous metals****Knowledge point**1. The role of alloying elements in steel;2. Classification and grades of carbon steel and alloy steel;3. Grades and performance characteristics of alloy structural steel, alloy tool steel, special performance steel;4. Graphitization of cast iron, grades, organization, performance characteristics and applications of common cast iron;5. Performance characteristics, grades and applications of non-ferrous metals.**Skill requirements**1. Master the role of alloying elements in steel, and master the classification, grades and performance characteristics of carbon steel and alloy steel;2. Can correctly choose carbon steel, alloy steel and cast iron;2. Ability to distinguish between ferrous and non-ferrous metals.**Teaching difficulties**1. The existence form of alloying elements in steel and the influence on the properties of steel;2. Strengthening mechanism of copper and its alloys and aluminum and its alloys. The formation process of the bearing alloy;3. Teaching of teaching skills;4. Comprehension and application of innovative management methods for course instruction. |
| **Unit 4 Selection of non-metallic materials, composite materials, new materials and materials****Knowledge point**1. Classification, performance and application of non-metallic materials;2. Characteristics of composite materials.3. Functions and features of various new materials.4. Selection principle of mechanical engineering materials, method of material selection..**Skill requirements**1. Be able to understand the characteristics and performance of non-metallic materials, composite materials, new materials, and the differences between them;2. Can understand the classification, grades, basic performance and application range of commonly used engineering materials3. Ability to master the classification and application of commonly used non-metallic materials.**Teaching difficulties**1. Knowledge of a large amount of non-metallic materials needs to be taught in a limited time;2. Innovative understanding and application of the evaluation method of the management examination;3. Self-study process analysis and self-improvement methods. |
| **Unit 5 Material forming process** **Knowledge point**1. Sand casting method, characteristics, defects, selection of sand casting position, parting surface and casting process parameters, sketching process of typical castings;2. Metal plastic deformation and its influence on metal structure and properties, metal forging properties and its influencing factors; characteristics and process of free forging and hammering die forging, simple forgings. Characteristics of other die forging methods;3. Welding metallurgy process and its influence on the microstructure and properties of welded joints, weld stress and deformation of weldments, and measures for obtaining high-quality weldments;4. Characteristics of common welding methods;5. New processes, new technologies and their development trends.**Skill requirements**1. Have the ability to select casting methods and related casting materials reasonably, and can correctly select casting thermal processing methods and processes;2. Have the ability to select forging method and related forging materials reasonably, and can correctly select forging thermal processing methods and processes;3. Have the ability to select welding methods and related welding materials reasonably, and can correctly select welding thermal processing methods and processes.4. Understand new technologies and trends in casting, forging and welding**Teaching difficulties**1. Teaching of teaching skills;2. The understanding and application of the innovative management method for the course teaching. |

（二）教学单元对课程目标的支撑关系

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| 课程目标教学单元 | 1 | 2 | 3 | 4 | 5 | 6 |
| 第一单元 金属材料的性能和组织结构 | √ |  | √ | √ | √ | √ |
| 第二单元 钢的热处理 |  | √ | √ | √ | √ | √ |
| 第三单元 钢铁材料和有色金属 | √ |  | √ | √ | √ | √ |
| 第四单元 非金属材料 | √ |  | √ | √ | √ | √ |
| 第五单元 材料的成型工艺 |  | √ | √ | √ | √ | √ |

（三）课程教学方法与学时分配

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| 教学单元 | 教与学方式 | 考核方式 | 学时分配 |
| 理论 | 实践 | 小计 |
| 第一单元 金属材料的性能和组织结构 | 案例式教学翻转课堂 | 课程作业书面测验实验操作及报告 | 8 | 8 | 16 |
| 第二单元 钢的热处理 | 案例式教学翻转课堂 | 课程作业书面测验实验操作及报告 | 8 | 8 | 16 |
| 第三单元 钢铁材料和有色金属 | 案例式教学翻转课堂 | 课程作业书面测验 | 10 |  | 10 |
| 第四单元 非金属材料 | 案例式教学翻转课堂 | 课程作业书面测验 | 12 |  | 12 |
| 第五单元 材料的成型工艺 | 案例式教学翻转课堂 | 课程作业书面测验 | 10 |  | 10 |
| 合计 | 48 | 16 | 64 |

（四）课内实验项目与基本要求

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| --- | --- | --- | --- | --- |
| 序号 | 实验项目名称 | 目标要求与主要内容 | 实验时数 | 实验类型 |
| 1 | Metallographic sample preparation and microstructure observation | Mastering the whole process of metallographic sample preparation;Understanding the main factors affecting the inspection results of metallographic specimens; Understanding the basic principles of metallographic microscopy;Students are trained to use metallographic microscope correctly, to design and complete experiments independently, and to analyze and judge the sample structure; | 4 | ④ |
| 2 | Observation and analysis of equilibrium microstructure of iron carbonalloy | Understand and familiarize oneself with the microstructure characteristics of iron carbon alloys in equilibrium state;Understand the effect of carbon content on the equilibrium structure of iron-carbon alloys, and establish the relationship between the Fe Fe3C state diagram and the equilibrium structure;Understand the transformation laws of balanced organizations and be able to apply the law of leverage;Analyze the influence of carbon content on the microstructure of iron-carbon alloys, and deepen the understanding of the interrelationship between composition, structure, and properties | 4 | ④ |
| 3 | Hardness testing of materials | Understand the basic principle of hardness measurement and the application range of commonly used hardness testing methods;Master the main structures and operating methods of Brinell hardness tester, Rockwell hardness tester, and Rockwell hardness tester;Learn to use a hardness tester correctly. | 4 | ④ |
| 4 | Heat Treatment and Hardness Testing of Carbon Steel | Knowing the effects of different heat treatment processes on the mechanical properties of 45# steel; Observing the microstructure of carbon steel after heat treatment;Understanding the heat treatment mechanism;Training and improving students' ability to analyze and solve practical problems of heat treatment process independently. | 4 | ④ |
| 实验类型：①演示型 ②验证型 ③设计型 ④综合型 |

四、课程思政教学设计

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| **第一层次“教的设计”**（1）结合《工程材料及成型技术基础》教学内容特点，抓住课程教学中思政教育的切入点。本课程的思政教学切入点如下：①以材料的发展历程、新材料、新工艺、新设备的开发应用为切入点，将最新的关于材料类的新闻资讯、科研动态、应用实例引入课堂，例如在锻压工艺中，通过视频介绍国内外锻压设备及我国大型锻压设备在国防、航天、军事等领域的实际应用，以此为切入点激发学生的爱国热情，增强其民族自豪感，激励其为国家振兴、民族强盛而努力学习。②以课程教学过程中始终贯穿的“组织决定性能”这一规律为切入点，向学生传达内因和外因的辩证关系，引导学生增强自我管理能力，激励学生增强自信心。③以材料加工处理的行业现状、存在的问题作为切入点。比如以热加工工艺的能耗、资源消耗、工艺更新等问题引导学生重视专业课学习，分析国内外科技差距，为将来解决上述行业所面临的共同难题贡献自己的力量，培养学生树立社会责任感。④实验教学中从实验结果分析及其注意事项为切入点，引导学生重视实践操作，培养学生严谨求实的工作作风和一丝不苟的工匠精神。（2）借助人物故事及工程案例传达思政观点《工程材料及成型技术基础》与新材料、新技术、新工艺、新设备等工程项目密切相关，教学过程中也会讲述一些材料发展史上的典型人物及工程案例，在增加课程趣味性的同时也能很好地传达本课程的思政观点。例如在讲授材料冲击韧性时，引入史上“泰坦尼克号沉没”事件，因该事件曾被搬上银幕广为人知，教学过程中更易引起学生共识，达到课程思政的教学效果，通过该案例引导学生学习过程中要有创新精神，工匠精神，也帮助学生认识到工作严谨的重要性，学会多角度分析思考问题的重要性。**第二层次“学的设计”**（1）课上学习：作为专业技术基础课的《工程材料及成型技术基础》，是一门与实践密切相关的课程，尤其是涉及加工工艺的内容，生产中有大量的优秀案例，教师通过针对生产案例设计相关分析讨论环节实现课程思政目标，例如，在学习焊接工艺时，以我国上海的卢浦大桥为例，在介绍卢浦大桥在桥梁建造史上的10项突出成就基础上，要求学生通过阅读资料分析该桥在焊接工艺采用的哪些先进技术，工艺实施的难点在哪里？国外类似的桥梁是如何建设的？通过上述的教学活动安排，学生在学习专业知识的同时，既了解了外内外的技术发展状况，又利于激发学生的爱国热情。（2）课下学习：当今是知识量爆发的时代，学生在课堂上接触的知识可以说不及知识海洋中的沧海一粟，课堂学习仅起到一个学习导向激励作用，更大量的知识摄取在于课堂之外。为了更好地调动学生学习情绪，需要学生了解课程的发展前沿及国内外的发展现状，激发学生的学习热情及爱国情怀，针对教学内容中的新材料、新工艺给学生布置相关的论文写作，通过大量查阅文献，使学生既了解了国内外的技术差距，又明确了今后努力发展的工作方向，激发爱国热情，坚定工作信念。**第三层次“效果评价”的设计**《工程材料及成型技术基础》的课程思政效果如何主要通过下列3种形式进行评价。（1）教学过程中，通过课堂讨论、论文写作等形式进行直接阐述评价。（2）课程结束，借助调查问卷了解课程思政对学生人生发展的影响。（3）课程结束，通过学生的课程总结，了解课程思政对学生思想的影响。 |

五、课程考核

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| 总评构成 | 占比 | 考核方式 | 课程目标 | 合计 |
| 1 | 2 | 3 | 4 | 5 | 6 |
| X1 | 50% | Exam (Open book exam, full content, 120 minutes) | 20 | 20 | 20 | 20 | 10 | 10 | 100 |
| X2 | 25% | Homework & Attendance | 25 | 25 | 20 | 20 |  | 10 | 100 |
| X3 | 25% | Experiment report | 15 | 15 | 20 | 20 | 10 | 20 | 100 |

六、其他需要说明的问题

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| 无 |