**Engineering Materials and Forming Technologies**

SJQU-QR-JW-033（A0）

**1. Basic information**

**Course Code:** 【2080394】

**Course Credit:**【4】

**Specialty:** Mechanism，Business school

**Course nature：**【Departmental compulsory course】

**Course department：**Mechanical Engineering Department, College of Mechanical and Electrical Engineering

**Teaching material：**

Textbook: ChenZhaoXia: Mechanical Engineering Materials. Southwest Jiaotong University Press. 2016

Reference Materials:【Kenneth G…Budinski. Engineering Materials: Properties and Selection. 2002】

**Advanced Placement：**【Engineering design drawing(A)】, 【Engineering design drawing(B)】、【Engineering mechanics】

**2.Course Description**

"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.

**3.Courseselection advice**

"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.

**4.Course content**

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| **Unit** | **Knowledge point** | **Skill requirements** | **Teaching difficulties** |
| 1. Properties and organization of metallic materials (8 hours theory, 8 hours experiment) | 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. | 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. | 1. Iron carbon phase diagram;  2. Master and familiar with the teaching skills;  3. Flip the psychological barriers in the classroom. |
| 2. Heat treatment and surface strengthening technology of steel (8 hours theory, 8 hours experiment)) | 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. | 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. | 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. |
| 3. Steel materials and non-ferrous metals (10hours theory) | 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. | 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. | 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. |
| 4. Selection of non-metallic materials, composite materials, new materials and materials (12hours theory) | 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. | 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 materials  3. Ability to master the classification and application of commonly used non-metallic materials. | 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. |
| 5. Material forming process (10 hours theory) | 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. | 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. | 1. Teaching of teaching skills;  2. The understanding and application of the innovative management method for the course teaching. |

**5.Name and Basic Requirements of Experiment in Class**

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| Item | Name of Experiment | Main Contents | Hours | Typeof Experiment | Remarks |
| 1 | Metallographic sample preparation and microstructure observation | 1. Mastering the whole process of metallographic sample preparation; 2. Understanding the main factors affecting the inspection results of metallographic specimens; 3. Understanding the basic principles of metallographic microscopy; 4. Students are trained to use metallographic microscope correctly, to design and complete experiments independently, and to analyze and judge the sample structure; | 8 | Comprehensive |  |
| 2 | Heat Treatment and Hardness Testing of Carbon Steel | 1. Knowingthe effects of different heat treatment processes on the mechanical properties of 45# steel; 2. Observingthe microstructure of carbon steel after heat treatment; 3. Understandingthe heat treatment mechanism; 4. Training and improving students'ability to analyze and solve practical problems of heat treatment process independently. | 8 | Comprehensive |  |

**6.Evaluation method and results**

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| General composition（1+X） | Evaluation method | Proportion |
| 1 | Final exam (Open book exam, full content, 120 minutes) | 50% |
| X1 | Course assignments (Twice) | 10% |
| X2 | Written test (Once) | 20% |
| X3 | Experiment report (Twice) | 20% |

"1" is generally a summary evaluation, "X" is a procedural evaluation, and the number of "X" is generally not less than 3 times. Whether it is "1" or "X", it can be a pen and paper test, or it can be Performance evaluation. The method of curriculum evaluation that is compatible with the ability standard is less paper-and-pen test and more performance evaluation.

Commonly used evaluation methods include: classroom presentation, oral report, essay, journal, reflection, investigation report, personal project report, group project report, experiment report, reading report, work (selection), oral test, classroom test, end-of-term closed book , end-of-life exams, job site assessments, self-assessments, peer assessments, etc. The general evaluation of extracurricular extended reading should be part of the “X”.

If the same course is taught by multiple teachers, the course group will discuss and decide the content, frequency and proportion of X.

**7. Teachingschedule**

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| **Calendarweek** | **Contents** | **Teaching method** | **Assignment** |
| 1 | Introduction  Development & classification of materials;  Materials properties | Lecture |  |
| 2 | Crystal Structure & Defect of Metals;  Iron-carbon alloy, and its phase & Analysis and application of iron carbon phase diagram | Lecture | Review material classification |
| 3 | Experiment 1 Preparation of metallographic specimens and observation of microstructure (part 1);  Experiment 1 Preparation of metallographic specimens and observation of microstructure (part 2) | Practice |  |
| 4 | Experiment 1 Preparation of metallographic specimens and observation of microstructure (part 3);  Experiment 1 Preparation of metallographic specimens and observation of microstructure (part 4) | Practice |  |
| 5 | Transition of steel during heating and cooling;  Isothermal and continuous cooling transition curve ofsupercooled austenite | Lecture | Course work 1 |
| 6 | Heat treatment of steel;  Chemical heat treatment of steel | Lecture |  |
| 7 | Experiment 2 Heat treatment and hardness test of steel (part 1);  Experiment 2 Heat treatment and hardness test of steel (part 2) | Practice |  |
| 8 | Experiment 2 Heat treatment and hardness test of steel (part 3);  Experiment 2 Heat treatment and hardness test of steel (part 4) | Practice | Report |
| 9 | Role of non-ferrous metal elements in steel;  Classification and performance characteristics of carbon steel | Lecture |  |
| 10 | Cast iron;  Non-ferrous metal (Copper, Aluminum) | Lecture |  |
| 11 | Non-ferrous metal (Titanium);  Classification, properties and application of non-metal (part 1) | Lecture | Report 2 |
| 12 | Classification, properties and application of non-metal (part 2);  Classification, properties and application of composite | Lecture |  |
| 13 | New materials;  Selection principle of mechanical engineering materials (part 1) | Practice |  |
| 14 | Selection methods of mechanical engineering materials (part 2);  Forming technology----casting | Practice |  |
| 15 | Forming technology----forging;  Forming technology----welding | Lecture | Course work 2 |
| 16 | Characteristics of common welding methods;  New technologies and their development | Lecture |  |

Written by: C:\Users\fanli\AppData\Local\Temp\1646223023(1).pngfanli Approved by: zhang