

Engineering Materials 1

Syllabus Number

1F201

Basic Major Subjects

Elective Requisites 2
credit

ISOGAI, Takeshi

1. Course Description

In this course, following topics are taught;

- (1) Crystal lattice; Plastic deformation of metallic materials; Phase diagram; Mechanical behavior of materials
- (2) Steels: Transformation of pure iron; Phase diagram of Fe-C alloy; Microstructure of steels; Heat treatment; Classification of carbon steels
- (3) Steel alloys; Steels at high temperatures; Heat-resistant materials; Cast irons

2. Course Objectives

The objective of the course is to provide students with a basic understanding of material science required for mechanical engineers.

3. Grading Policy

Your overall grade in the class will be decided based on followings:

- Term-end examination (60%)
- Mini tests in the class (40%)

Those who are absent from this exam without justifiable reasons are not eligible to take the exam again. Feedback will be given by returning the previous mini tests and comments on the answer.

4. Textbook and Reference

Textbook

Kaizo Monma Industrial Materials -SI Unit Version
Jikkyo Publication (1993) ISBN 978-4-407-02328-2

Reference

Ohmi Miyagawa and Masayuki Yoshiwa Material Science to Fully Understood Morikita Publishing (1993) ISBN 4-627-66280-7

5. Requirements(Assignments)

Before taking a course, please review the structure of atoms and basic of chemical bonding learned by "Chemistry 1" etc carefully

As the preparation for first lesson, please review chemical bonds (covalent bonds, ionic bonds, metal bonds) learned by "Chemistry 1" and summarize the essential points in the A4 size paper and bring it to the lesson.

Please read the relevant part of the text in advance and go to class. (About 1.5 hours)

Please review the important items you learned in class by using texts and notes. Also, let's try to answer the exercises that you did during class. (1.5 hours)

The details of preparations for the second and subsequent rounds will be instructed in class.

6. Note

The diagram / table will be shown by using a projector and advance the lesson while adding explanations with a board book. It is important to acquire the habit of taking notes during the classes by themselves. You can bring your handwritten notes during the final exam.

7. Schedule

- [1] Introduction: Types and properties of industrial materials, Types and properties of metal materials, Material properties and materials selection
- [2] Structure of metal material: Crystal structure, Crystal lattice, Lattice defect
- [3] Plastic Deformation of Metallic Material: Metallic Crystal and Plastic Deformation, Dislocation, Sliding Deformation
- [4] Work hardening and metal phase: Work hardening, Recovery, Recrystallization, Phase of metal, Alloy, Solid solution
- [5] Equilibrium state of alloy 1: Solidification of metal, State diagram and its view, State diagram for full rate solid solution
- [6] Equilibrium state of alloy 2: Eutectic reaction, State diagram for eutectic type, Solubility curve
- [7] Mechanical properties of metallic materials: Tensile strength, Hardness, Impact test, Fatigue, Ductile fracture, Brittle fracture
- [8] Iron and steel 1: Production method of steels, Transformation of pure iron
- [9] Iron and steel 2: State diagram of carbon steel, Eutectoid steel
- [10] Iron and Steel 3: Heat treatment, Quenching, Tempering, Annealing, Normalizing
- [11] Iron and steel 4: Standards and applications of carbon steel, Cold rolled steel plate
- [12] Structural alloy steel: High tensile strength steel, Free cutting steel, Alloy steel used in heat treatment, Alloy steel standards and uses
- [13] Properties of steel at high temperature: High temperature oxidation, Mechanical properties of steel at high temperature, Creep, Heat resistant steel
- [14] Cast iron: Structure and state diagram of cast iron, Gray cast iron, Various cast iron

