

# General Thermodynamics

Special Subjects  
Elective 2 credit

SHINOTAKE, Akihiko

## 1. Course Description

We will learn the concept and fundamental principle of thermodynamics in relation to basic knowledge of physics and chemistry. Learn about thermodynamics first law, thermodynamics second law, heat, work and energy, energy conversion, the relation between combustion, chemical reaction and heat. After that, we will learn the operating principle, cycle and efficiency of the thermal equipment to which thermodynamics is applied. Learn how to analyze the gas cycle (internal combustion engine) and the steam cycle (external combustion engine) and advance classes with exercises and discussions so that you can apply what you learned as practical.

## 2. Course Objectives

Thermodynamics is important as one of the basic sciences describing physical phenomena in the natural world, and it is the academy handling the movement of heat and energy conversion. By learning the basic concepts and basic principles of thermodynamics, the mechanisms and efficiency of the operation of thermal equipment and heat engines to which thermodynamics are applied, we can understand that thermodynamics makes a great contribution to human life and gives a big influence. We can also understand that improvement of heat engine efficiency and development of new heat equipment that can make a big contribution in solving environmental and energy problems.

## 3. Grading Policy

Submission of exercise problem report (75%), content of lesson and discussion (25%) are the basis of evaluation.

## 4. Textbook and Reference

Textbook

Edited by The Japan Society of Mechanical Engineers JSME Text Series "Thermodynamics"  
Maruzen Publishing

Reference

Edited by The Japan Society of Mechanical Engineers JSME Text Series "Problems in Thermodynamics" Maruzen Publishing

Takanori Saito, Kazuhiro Hamaguchi, Koichi Hirata Thermodynamics to be learned for the first time  
Ohmsha

Ruggero Micheletto, Aki Tosaka The thermodynamics studied in English and Japanese Kyoritsu Shuppan

## 5. Requirements(Assignments)

It is assumed that mathematics (calculus), physics, and chemistry (basic level of university) are well understood. It is desirable that you take classes equivalent to undergraduate "thermodynamics". Preliminary training should prepare part related to class contents of each class using reference books and textbooks/notes from undergraduate (1 - 1.5 hours). After class, please review the contents of each lesson and prepare a report as exercise (1.5 - 2 hours).

## 6. Note

Please bring a scientific calculator because you may need to solve problems in exercises during class.

## 7. Schedule

- [1] Significance of thermodynamics and historical background
- [2] Basic Concept and Thermodynamics Zeroth Law, Unit Systems and Units
- [3] First law of thermodynamics
- [4] The second law of thermodynamics, Carnot cycle
- [5] Concept and calculation of entropy
- [6] Effective energy use and exergy
- [7] General equation of thermodynamics
- [8] Chemical reaction and combustion (1) Chemical reaction and equilibrium
- [9] Chemical reaction and combustion (2) Concept of combustion and calculation of combustion
- [10] Gas cycle (1) Piston engine cycle
- [11] Gas cycle (2) Gas turbine, other cycles
- [12] Steam cycle (1) Property and state change of water and steam
- [13] Steam cycle (2) Steam engine cycle
- [14] Refrigeration cycle and air conditioning
- [15] Summary, Exercise, Discussion