

# Exercises in Mechanical EngineeringB

Syllabus Number

1E304

Special Subjects

Elective 2 credit

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## 1. Course Description

In fluid dynamics exercises, the basis of fluid mechanics such as the physical properties of fluids, hydrostatics, the relationship between pressure and velocity, and the hydrodynamic force in flow around a body are studied and the understanding is deepened through practices.

In thermodynamics exercises, basic subjects such as the first law and the second law of thermodynamics, energy, as well as subjects relating to real industry processes such as combustion, gas cycle, and steam cycle are studied, and the understanding is deepened through practices.

## 2. Course Objectives

Of the four basic types of dynamics of mechanical engineering (material mechanics, machine dynamics, fluid dynamics, and thermodynamics), fluid dynamics and thermodynamics are treated in this course. For each type, confirmation of the important matters, commentary of exercises, and problem practice will be performed. The aim of this course is for the student to acquire applicable and practical ability to design, develop, and improve devices and processes by utilizing the basic knowledge of this field as a mechanical engineer.

## 3. Grading Policy

Evaluation will be conducted based on the submission status and contents of the exercise assignment report. If attendance is less than 2/3 or more, students will be disqualified. We will confirm the degree of achievement and give feedback on the whole in the last lesson.

## 4. Textbook and Reference

Textbook

Saito Takanori, Hamaguchi Kazuhiro, Hirata Koichi Fluid dynamics exercise: None in particular.

Thermodynamic exercise: The thermodynamics to be learned for the first time Ohmsha

Reference

Edited by JSME JSME text series "Thermodynamics"; "Thermodynamics of Exercise" Published by Maruzen Shuppan Co.Ltd.

## 5. Requirements(Assignments)

Fluid dynamics 1 to 3, Thermodynamics, Heat and Heat Engine are already studied and it is assumed to be fully understood. As for preparation, please review fluid dynamics and thermodynamics using notes and textbooks (about 1.5 hours). After class, please review the content of the problem exercises each time, complete the report of the assignment and submit it (about 1.5 hours).

## 6. Note

From the 2nd lesson onwards, we will promote lessons mainly on problem exercises.

The 2nd to 8th lesson will be focus on field of fluid dynamics (responsible: Koroyasu).

The 9th to 15th lesson are thermodynamic fields (responsible: Shinkotake).

Please bring a scientific calculator.

## 7. Schedule

- [1] Orientation (fluid dynamic exercise, thermodynamic exercise). How to proceed classes
- [2] Pressure in stationary fluid
- [3] Continuum equation and Bernoulli's equation, and their applications 1
- [4] Continuum equation and Bernoulli's equation, and their applications 2
- [5] Law of Conservation of Momentum
- [6] Energy balance of pipe system and power requirement of pump
- [7] Application of Navier Stokes equation (steady state)
- [8] Application of Navier Stokes equation (unsteady state)
- [9] Basic concept of thermodynamics, first law  
[Preparation] Review the Chapter 3 (p. 39-49) of the "Thermodynamics" textbook in conjunction with the lesson notes of the relevant section.  
[Exercise] In principle, it is necessary to solve problems on their own by referring to textbooks, reference books, and notes. But it is possible to solve them by pair work and group work as appropriate. (The same shall apply after the 10th round)  
[Review] Solve problems that did not end in lesson time, complete and submit as a report at the start of the next class. (The same shall apply after the 10th round)
- [10] Second law of thermodynamics  
[Preparation] Review the Chapter 4 (p.51-58) of the "Thermodynamics" textbook in conjunction with the lesson notes in the relevant section.
- [11] Energy and exergy  
[Preparation] Review the Chapter 4 (p. 58 - 68) of the "Thermodynamics" in conjunction with the lesson notes of the corresponding section.
- [12] Chemical reaction and combustion  
[Preparation] Review the Chapter 2 (p. 29-38) of the "Thermodynamics" textbook in conjunction with the lesson notes of the relevant section.
- [13] Gas cycle  
[Preparation] Review the Chapter 5 (p.69-84), Chapter 6 (p.85-107) of the textbook of "Thermodynamics" in conjunction with the lesson notes of the relevant section.

- [14] Steam cycle and the other  
[Preparation] The textbooks of "Thermodynamics" Chapter 8 (p. 121 - 146), Chapter 9 (p. 147 - 169) should be reviewed in conjunction with the lesson notes of the corresponding section.
- [15] Review and summary of thermodynamic exercises  
[Preparation] Review the textbooks and class notes of "Thermodynamics" about the areas of the 9th to 14th exercise in general, which are recognized as insufficiently understood.  
[Review] Review problems related to problems you did not understand using textbooks and notes.