科目ナンバリング	U-LAS12 10034 LE57						
授業科目名<英訳>	Thermodynamics-E2 Thermodynamics-E2			担当者所属職名・氏名	理学研究科　准教授　DECHANT, Andreas		
群	自然科学科目群			分野(分類)	物理学(基礎)	使用言語	英語
旧群	B群	単位数	2単位	週コマ数	1コマ	授業形態	講義（対面授業科目）
開講年度・開講期	2026・後期	曜時限	水3	配当学年	主として1回生	対象学生	理系向

[授業の概要・目的]

This course provides a comprehensive overview of equilibrium thermodynamics. What makes thermodynamics at the same time appealing but also a little bit mysterious, is that its laws are universal: All macroscopic physical objects that we can observe in our daily lives must obey the laws of thermodynamics. Apart from introducing the various thermodynamic laws and relations and learning how to apply them to different physical systems, we will also understand why thermodynamics is so universal.
The first part introduces the basic concepts of thermodynamics such as thermodynamic systems, environment and state variables. We will formulate the first law of thermodynamics, which relates heat and work through internal energy, and the second law of thermodynamics, which characterizes irreversibility using entropy.
In the second part, the various thermodynamic potentials, such as free energy, are introduced and applied to concrete examples by viewing energy and entropy as thermodynamic functions. Here we will also study the Maxwell relations, which provide a connection different physical quantities.
The third part will deal with phase transitions and phase equilibria. We will understand how to describe a liquid chaning into a gas, and under which conditions both liquid and gas can exist at the same time.

[到達目標]

- Understanding heat and entropy and how they appear in the laws of thermodynamics.
- Being able to apply thermodynamics to describe physical processes.
- Understanding why thermodynamics is so fundamental for many everyday phenomena.

[授業計画と内容]

Week 1-8: Fundamental principles of thermodynamics
- System, environment, and boundary
- States, processes, and equilibrium: the zeroth law
- Heat, work, and energy: the first law
- Irreversibility and entropy: the second law
- Carnot heat engine and efficiency

Week 9-11: Thermodynamic potentials
- State variables and differentials
- Energy and entropy revisited
- Free energy, enthalpy and all the others
- Maxwell relations
- Selected applications

Week 12-14: Phase transitions
- Phases and Gibbs' rule
- Phase transitions, critical exponents, and scaling

Week 15：Final written examination
Week 16：Feedback

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Thermodynamics-E2(2)

[履修要件]

Students are recommended to attend a basic course on mechanics (**物理学基礎論A** or similar) before taking this lecture. The necessary mathematical details (mainly multi-variable calculus) will be provided in class.

[成績評価の方法・観点]

The final score will be determined by weekly assignments (50%) and the final written examination (50%). The total score will be on a scale from 0 to 100 and students will need at least 60 points to pass.

[教科書]

C.J. Adkins 『Equilibrium thermodynamics』 （Cambridge University press）ISBN:0521274567

[授業外学修（予習・復習）等]

Students will be asked to complete and hand in assignments.

[その他（オフィスアワー等）]

Most communications between the instructor and students will be carried out using LMS, where you can also find announcements and the assignments. Students can also contact the instructor directly via e-mail, or during the office hour on Thursday from 15:00-16:00.

[主要授業科目（学部・学科名）]

理学部