

EEN-E1030, Thermodynamics in Energy Technology

Fall, 2021

Teaching personnel

Teacher in charge

Senior University Lecturer Henrik Holmberg

henrik.holmberg@aalto.fi

Mobile 050-3841781

Sähkömiehentie 4 J, Room 206, second floor

Assistants

Dr. Ali Khosravi ali.Khosravi@aalto.fi

PhD student Behnam Talebjedi behnam.Talebjedi@aalto.fi

Lectures and calculation exercises

Duration: I-II periods

Lectures:

1st period: Lectures will be given online via Zoom on Monday at 10.15 – 12.00. You find a zoom link “Virtual Classroom” on MyCourses under section “General”

2nd Period: We have not yet got exact information on teaching arrangements in the second period. I will inform you on these arrangements later.

Calculation exercises:

1st period: Calculation exercises will be given online via Zoom link “Virtual Classroom” on Thursdays at 12:15-13:45.

2nd Period: I will inform you later.

Computer exercise HSC-chemistry. Computer exercise won't be held this Fall.

Main course content

- Enthalpy
- Entropy
- Chemical equilibrium
- Exergy analysis
- Thermodynamics of solutions
- Thermodynamics of humid air
- Real gases

Learning outcomes

The most important learning outcomes are usually related to Star Problems (see next slide) in calculation exercises

About calculation exercises

- Exercises will be uploaded on MyCourses on Friday before the next week's lecture and exercise. Some questions (but not all) are both in Finnish and English. Solutions are only in English.
- There will be a Star Problem in every exercise. If you solve and return the problem you can get some extra points, which can improve your final grade.
- The assessment scale is 0-3 points. The final sum is divided by 10 => you can maximally get 3 extra points.
- Extra points are rounded normally. For example, 2.5 points give you 3 extra points and 2.4 give you 2 extra points.
- **Assistants give you some help online via Zoom in calculation exercises.** You must return the answer of the star problem next Thursday by 12.00 at the latest.
- You must submit your solution to a return folder on MyCourses. You find folders (Round 1, Round 2, Round 3,...) under Assignments where you can upload your solution by the dead line. You can solve the problem by hands and submit the picture of your solution on MyCourses.
- Answers to other calculation problems are given when problems are uploaded on the course page. If you have any questions about other problems, you can make them in online exercises.
- Answers to star problems will be uploaded on the course page during the course.

Course materials

- Lampinen Markku J., Seppälä Ari, Kemiallinen termodynamiikka energiateknikassa/ Chemical Thermodynamics in Energy Technology. The material is both in Finnish and English.
- A compendium about the thermodynamics of humid
- A compendium about real gases
- All slides after the lecture will be uploaded on MyCourses-page.

You can download all materials as pdf-files on MyCourses-page under section "Materials."

Chapters 11 – 13 in the Finnish course material are not included in the course content and therefore they have not been translated into English.

Passing the course

To pass the course you must get 9/24 points in the exam. This is the only requirement.

About the exam

- The exam will be held on December 13 at 9-12 either as a normal exam at the university (primary option) or as a home exam (secondary option). You will get more detailed information on the exam in the second period.
- There will be four problems in the exam. You can maximally get 6 points for each problem (scale 0,1,2..6) => maximum points of the exam are 24 points.
- If you have returned star problems, the extra points are considered since you have passed the exam. In other words, you **WON'T PASS** the course if you get 7 points in the exam and you have 2 extra points.
- If we have a normal exam, you can take the summary of course equations and necessary thermodynamic tables and diagrams with you in the normal exam. You find these files on the course page. Start to use this material right away in the first calculation exercise. You are not allowed to take any other material in the normal exam.

Preliminary course schedule, lectures

Lecture 1, 13th September,

Introduction to the course, definitions of thermodynamic states and introduction to enthalpy, h,s diagram of water

Lecture 2, 20th September

Change of enthalpy and reaction enthalpy

Lecture 3, 27th September,

Entropy and Euler's homogenous theorem

Lecture 4, 4th October,

The Gibbs energy, chemical potential, phase equilibrium

Lecture 5, 11th October,

Equilibrium constant

Lecture 6, 18th October,

Calculating the chemical equilibrium, phase rule

Lecture 7, 1st November,

Exergy analysis

Lecture 8, 8th November,

Thermodynamics of solutions

Lecture 9, 15th November,

Thermodynamics of humid air, part 1

Lecture 10, 22nd November,

Thermodynamics of humid air, part 2

Lecture 11, 29th November,

Real gases and the law of corresponding states

Changes are possible