Vacuum Science & Technology, 7.5 credits

Vakuumvetenskap och -teknik, 7.5 hp

Third-cycle education course

6FIFM06

Department of Physics, Chemistry and Biology

Valid from: Second half-year 2025

Approved by **Approved**

Registration number

Entry requirements

Prerequisites: Thermodynamics and modern physics, or Thermodynamics and Statistical Mechanics, or Modern Physics I, or similar courses.

Learning outcomes

The aim of the course is to give students a thorough understanding of how vacuum components and vacuum systems work, and the fundamental physics and chemistry behind them. This means that students should:

- Understand and be able to define the vacuum concepts (ideal, rough, low, high, ultrahigh, etc…)
- Understand and be able to explain in own words the kinetic theory of gases
- Understand and be able to explain in own words the principles for gas flow at low pressures
- Understand and be able to explain in own words physico-chemical phenomena in vacuum
- Be able to apply the knowledge and understanding listed above to practically and theoretically relevant situations in vacuum science and technology
- Communicate this understanding orally and in writing
- Be able to critically reflect on scientific articles relevant to vacuum science and technology

Contents

The course content can be broadly characterized into “theory” and “practice”. Strong emphasis is placed on the connection between the two.
“Theory”:

- General aspects and history of vacuum science and technology
- Professional organizations
- Basic concepts
- The kinetic theory of gases as applied to vacuum science and technology
- Gas flow at low pressures
- Physico-Chemical phenomena in vacuum (Evaporation, condensation, solubility, permeation, adsorption, absorption, desorption)

“Practice”:

- Pumping – general aspects and an overview of different types of pumps
- Pumping – physics and principle of operation of common pumps
- Measurement of low pressure - Direct and indirect gauges and the physics behind them
- Materials and sealing techniques
- Vacuum systems

Educational methods

The course consists of a lecture series with home assignments, a report on laboratory task, and a ending seminar in peer-review format.

Examination

Examination includes i) Continuous examination (U,G) 3.5 hp, ii) Report on laboratory task (U,G) 3.5 hp, and iii) Participation in ending seminar (U,G) 0.5 hp.

Continuous examination (quiz and home assignment): At the start of the lecture, there is a pre-lecture quiz on the content of the upcoming lecture. After each lecture (except the last one), an individual home assignment will be given. There will be 9 quizzes and 8 home assignments = 17 points in total. “Passing” continuous examination requires more than 13 points. If you get less than 13 points, you will need to do assignments in a written home exam, depending on how well you performed in the continuous examination.
Report on laboratory task: after lecture series, you need to write a laboratory report with a chosen assignment in connection to your research associated with vacuum science and technology. The laboratory/home assignments are examined through peer review and an end seminar, in which active participation is mandatory

Grading

Two-grade scale

Course literature

John F. O’Hanlon, A User’s Guide to Vacuum Technology, Wiley, 2003 (3rd edition), and additional handouts.

General information

The course is planned and carried out according to what is stated in this syllabus. Course evaluation, analysis and suggestions for improvement should be fed back to the Research and PhD studies Committee (FUN) by the course coordinator.