Faculty of Health, Science and Technology
Mathematics

Syllabus

Kinetic Theory

Course Code:	MAAD02
Course Title:	Kinetic Theory *Kinetisk teori*
Credits:	7.5
Degree Level:	Master's level
Progressive Specialisation:	Second cycle, has only first-cycle course/s as entry requirements (A1N)

Major Field of Study:
MAA (Mathematics)

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2019-02-18, and is valid from the Autumn semester 2019 at Karlstad University.

Prerequisites
Mathematics 90 ECTS credits, including at least 30 ECTS credits at the G2F level, and English 6 or B, or equivalent

Learning Outcomes
Upon completion of the course the student should be able to:
- state the Boltzmann equation - also for a discretized velocity variable - for simple monatomic gases, and extend it to gas mixtures and polyatomic molecules,
- give an account of some of the main properties of the Boltzmann equation,
- prove the main conservation laws and the H-theorem,
- derive the linearized collision operator and prove some of its main properties, such as being non-negative and symmetric, and determine its kernel,

- give an account of and be able to apply a few methods to create normal discrete velocity models and/or to determine if discrete velocity models are normal,
- formulate the half-space problem of condensation/evaporation in kinetic theory and the problem of existence of shock-profiles,
- state fundamental conditions of existence and give an account of some basic ideas behind the study of existence of solutions for the half-space problem of condensation/evaporation and the problem of existence of shock-profiles,
- solve the half-space problem of condensation/evaporation and the problem of existence of shock-profiles for a discrete velocity model with few velocities, such as a Broadwell model,
- define central concepts and formulate basic theorems and results from the field.

Content
The course covers the following:
- The Boltzmann equation for single monatomic gases, and extensions to gas mixtures and polyatomic molecules,
- Discrete velocity models for single monatomic gases, gas mixtures, and/or polyatomic molecules,
- The main properties of the non-linear Boltzmann equation, including conservation laws and the H-theorem,
- The linearized Boltzmann equation and some common boundary conditions,
- Construction of normal (without non-physical collision invariants) discrete velocity models,
- Half-space problems: Knudsen layers, evaporation/condensation phenomena, conditions of existence,
- Shock profiles: the Rankine-Hugoinot conditions and existence.

Reading List
See separate document.

Examination
Assessment is based on hand-in assignments and a written exam.

Grades
One of the grades Distinction (VG), Pass (G), or Fail (U) is awarded in the examination of the course.

Quality Assurance
Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate
A course certificate will be provided upon request.

Additional information
The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.