FSG3131 Kinetisk gasteori 7,0 hp

Kinetic Gas Theory

När kurs inte längre ges har student möjlighet att examineras under ytterligare två läsår.

Fastställande

Kursplan för FSG3131 gäller från och med HT11

Betygsskala

Utbildningsnivå

Forskarnivå

Särskild behörighet

Recommended prerequisites

An advanced course in fluid mechanics on undergraduate level is recommended.

Undervisningsspråk

Undervisningsspråk anges i kurstillfällesinformationen i kurs- och programkatalogen.

Lärandemål

The student will be able to describe the connection between the continuum mechanical Navier-Stokes equations for a gas and the kinetic theory description of a gas in thermal

non-equilibrium. Also, the student will be able to describe some effects typical to gases at Knudsen numbers of order one or larger, a limit not covered by the Navier-Stokes equations.

Kursinnehåll

After completing this course the student should be able to:

- Give the kinetic theory definitions of the macroscopic continuum properties/variables of a gas.
- State the requirements on a fluid flow for the continuum assumption to be a reasonable approximation.
- Describe the concepts of cross-section and mean free path in a gas and derive an expression for the mean free path.
- Use the mean free path concept to derive an approximate expression for viscosity and heat conductivity in a gas in terms of kinetic variables.
- State the Boltzmann equation and, make an interpretation of the different terms involved.
- State the Maxwellian distribution and when it is valid.
- Give examples of some typical kinetic effects not described by the Navier-Stokes equations.
- Give the main principles of a Direct Simulation Monte-Carlo Simulation (DSMC).
- Describe in broad outline the Chapman-Enskog method to derive the Navier-Stokes equations from the Boltzmann equation at small Knudsen numbers, in particular how viscosity and heat conductivity can be found from the molecular interactions.

Kursupplägg

About 10 hour lectures.

Project work in groups of 2 students.

Seminars with student project presentations with 2 students per 45 minutes.

Kurslitteratur

Course literature

Gombosi, T.I.

Gaskinetic Theory, Cambridge University Press, 1994

Dahlkild, A.A. and Söderholm, L.H.

Lecture notes in kinetic gas theory, 2011

Examination

Examinator beslutar, baserat på rekommendation från KTH:s handläggare av stöd till studenter med funktionsnedsättning, om eventuell anpassad examination för studenter med dokumenterad, varaktig funktionsnedsättning.

Examinator får medge annan examinationsform vid omexamination av enstaka studenter.

Lists of typical questions at examination are available for the oral exam.

Övriga krav för slutbetyg

The following items have to be approved in order to obtain a pass on the course:

- Project work and 4-page report on a DSMC-simulation
- Oral examination on kinetic theory of gases

Etiskt förhållningssätt

- Vid grupparbete har alla i gruppen ansvar för gruppens arbete.
- Vid examination ska varje student ärligt redovisa hjälp som erhållits och källor som använts.
- Vid muntlig examination ska varje student kunna redogöra för hela uppgiften och hela lösningen.