Faculty of Science

FYTN15, Theoretical Physics: Statistical Mechanics, 7.5 credits

Teoretisk Fysik: Statistisk mekanik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus is an old version, approved by Study programmes board, Faculty of Science on 2018-02-13 and was valid from 2018-02-13 , autumn semester 2018.

General Information

The course is for second-cycle studies for a Degree of Master of Science (120 credits) with a specialisation in physics.

Main field of studies	*Depth of study relative to the degree requirements*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

The purpose of the course is that the student should learn more advanced concepts and methods to describe interacting systems with many particles and critical phenomena.

Knowledge and understanding

Upon completion of the course, the student shall be able to:

- explain the basic concepts of statistical mechanics and the relationships between them,
- describe the Ising model and its assumptions and show its relationship with other models, such as the lattice gas,
- describe first- and second-order phase transitions and give examples,
- describe critical phenomena and explain the concepts of order parameter, correlation length, critical point and critical exponent,
- describe the transfer matrix method, mean field theory and renormalisation theory.

Competence and skills

Upon completion of the course, the student shall be able to:

- apply basic concepts of statistical mechanics,
- derive the Fermi-Dirac, Bose-Einstein, and Planck-distributions and apply them to describe systems such as electron and photon gases,
- derive relationships between critical exponents,
- apply the transfer matrix method, especially to solve the one-dimensional Ising model exactly,
- apply mean field theory, especially to show how the Ising model leads to the Weiss model for ferromagnetism,
- apply renormalisation theory, especially on the Ising model in one and two dimensions.

Course content

The course deals with statistical mechanics. Especially the following:

- the canonical partition function, the grand canonical partition function, Gibb's entropy and free energy,
- ideal gases: Fermi-Dirac, Bose-Einstein and Planck distributions,
- the Ising model,
- phase transitions, critical phenomena, critical exponents,.
- the transfer matrix method,
- mean field theory,
- renormalisation theory.

Course design

The teaching consists of lectures and exercises.

Assessment

The examination consists of written hand-in assignments, an oral seminar assignment and an oral test. Students who do not pass the regular exam are offered a re-examination shortly following the regular exam.

If required for a student with permanent disabilities to be granted an equivalent examination option compared to a student without disabilities, the examiner may, after consultation with the university's Disability Support Services, decide about an alternative form of examination for the student concerned.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course, a passed oral test as well as passed written hand-in assignments and passed seminar assignment are required. The final grade is determined by the results in the different parts of the examination. The weights of the different parts is given at the start of the course.

Entry requirements

The prerequisites required for admission to the course are: 75 credits in Physics and 45 credits in Mathematics or a Bachelor of Science in Physics, in both cases including knowledge corresponding to FYSB12 Basic Statistical Physics and Quantum Statistics, 7.5 credits. English 6/B and general entry requirements.

Further information

The course may not be credited towards a degree together with FYTN02 Statistical Mechanics.

Subcourses in FYTN15, Theoretical Physics: Statistical Mechanics

Applies from H22

2201 Statistical Mechanics, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction

Applies from H18

1801 Statistical Mechanics, 7,5 hp
Grading scale: Fail, Pass, Pass with distinction