Faculty of Science

FYTN02, Theoretical Physics: Statistical Mechanics, 7.5 credits

Teoretisk Fysik: Statistisk mekanik, 7,5 högskolepoäng

Second Cycle / Avancerad nivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2007-03-01 (N2007267). The syllabus comes into effect 2007-07-01 and is valid from the autumn semester 2007.

General information

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

Language of instruction: Swedish and English
If needed, the course is given in English in its entirety.

Main field of study	*Specialisation*
Physics	A1N, Second cycle, has only first-cycle course/s as entry requirements

Learning outcomes

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

The aims of the course are that, upon completion of the course, the student should have acquired the following knowledge and skills:

- The canonical partition function, the grand canonical partition function, Gibb's entropy and free energy: The student can explain the basic concepts of statistical mechanics, the relationships between them and their applications.
- The Ising model: The student can describe the Ising model and its assumptions and show its relationship with other models, such as the lattice gas.
- Phase transitions, critical phenomena, critical exponents: The student can describe first- and second-order phase transitions and give examples. The student can describe critical phenomena and explain the concepts of order parameter, correlation length, critical point and critical exponent. The student

can derive relationships between critical exponents.

- The transfer matrix method: The student can describe the method and apply it, especially to solve the one-dimensional Ising model exactly.
- Mean field theory: The student can describe the method and apply it especially to show how the Ising model leads to the Weiss model for ferromagnetism.
- Renormalisation theory: The student can describe the method and apply it especially on the Ising model in one and two dimensions.
- Knot theory: The student can describe the star-triangle relation and knows the relationships between knot theory and statistical mechanics.

Examples of problems that the student should be able to solve upon completion of the course:

- Start from the van der Waal's equation of state and derive the behaviour of the isothermal compressibility at the critical point.
- Show, that the van der Waal's equation of state essentially follows from the mean field approximation applied to the Ising model.

Course content

The course consists of the elements described above for a total of 7.5 credits.

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.

Grades

Grading scale includes the grades: 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.

Entry requirements

The prerequisites required for admission to the course are: English B and general entry requirements as well as knowledge equivalent to 90 credits in physics and 30 credits in mathematics.

Further information

The course may not be credited towards a degree together with FYSM01 if this includes FYTN02 as a module.