



FSK3759 Superconductivity and applications 6.0 credits

Supraledning och tillämpningar

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FSK3759 valid from Autumn 2019

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Good knowledge about basic concepts in vector analysis, like divergence, curl, line integrals, Gauss and Stokes theorems.

Good knowledge of Maxwell's equations and basic quantum physics.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

In order to show deeper knowledge about the theory of superconductivity and to show an ability to understand and describe the principles behind superconducting applications, the students should after having completed the course be able to:

- describe different theories of superconductivity and their ranges of validity
- in detail describe the difference between good conductors, perfect conductors and superconductors
- apply London theory, modified London theory and Ginzburg-Landau theory for superconductivity for both derivations and numerical calculations
- explain type-I and type-II superconductivity based on thermodynamic calculations of the Gibbs free energy for a superconductor
- discuss vortices and their properties in a superconductor both quantitatively and qualitatively, especially concerning energy losses in superconducting wires
- apply Bean critical state model
- derive equations for Josephson junctions and relate this to different applications within superconducting electronics
- describe various applications of superconductivity (superconducting wires, magnets, Maglev trains, SQUID:s, tomographs, measurement normals, superconducting electronics etc)
- conceptually analyze a suggestion for a superconducting application in a broad holistic perspective and in collaboration with other students
- deepen the knowledge of superconductivity within a field that relates to the PhD studies

Course contents

Properties of superconductors, Meissner effect, good conductors and perfect conductors. London theory for superconductors.

Thermodynamics for superconductors, type-I and type-II superconductivity.

Vortices in type-II superconductors, energy losses, Bean critical state model. Josephson junctions, quantum interferometers (SQUID:S), short and long Josephson junctions.

Ginzburg-Landau theory for superconductors,

Large scale applications (e.g. magnets, energy storage, advanced transportation) and applications in electronics (e.g. SQUID instruments, computers, measurement normals).

Examination

- FÖRA - Deepening task, 1.0 credits, grading scale: P, F
- INLA - Assignments, 2.5 credits, grading scale: P, F
- KONA - Partial exam, 2.5 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

KONA and INLA corresponds to similar parts in the course SK2759 Superconductivity and applications.

FÖRA is an individual deepening task within superconductivity. The subject and the way it is examined (either orally or in writing) is determined through an agreement between the student and the examiner.

Other requirements for final grade

A pass grade on all parts of the examination in the course.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.