IM2661 Superconductivity and Applications 6.0 credits

Supraledning och tillämpningar

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

Establishment

Course syllabus for IM2661 valid from Autumn 2016

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Physics

Specific prerequisites

Good knowledge about basic concepts in vector analysis, like divergence, curl, line inegrals, 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

The course aims at giving the students in depth knowledge and know-how within the theory of superconductivity in order to understand and describe the principles behind various superconducting applications.

After the course, the students shold be able to:

- describe different theories of superconductivity and their ranges of validity
- in detail describe the difference between good conductors, perfect conductors and super-conductors
- apply London theory, modified London theory and Ginzburg-Landau theory for supercon-ductivity 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 qualita-tively, 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).

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 instrumetns, computers, measurement normals).

Disposition

Lectures (with less than minimum number of active students, the course can instead be given by supervised self-studies).

Course literature

M. Andersson, Introduction to applied superconductivity, KTH (compendium)

Examination

- KON1 - Partial exam, 3.0 credits, grading scale: A, B, C, D, E, FX, F
- INL1 - Written assignments, 3.0 credits, grading scale: A, B, C, D, E, FX, 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.

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

Final grade on the course is based on the total number of points on the hand-in problems and the short exams.

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.