IM2661 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 IM2661 valid from Autumn 2009

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, Gauss and Stokes theorems
Knowledge about basic solid state physics (corresponding to Charles Kittel, "Introduction to solid state 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 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)

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).

Course literature

M. Andersson, Introduction to applied superconductivity, kompendium, KTH

Extra literature:

T.P.Orlando and K.A.Delin, "Foundations of applied superconductivity", Addison-Wesley, ISBN 0-201-18323-4

K.Fossheim and A.Sudbø, "Superconductivity - physics and applications", Wiley, ISBN 0-470-84452-3

Examination

- TEN1 - Examination, 6.0 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.

Other requirements for final grade

Written exam (TEN1, 6.0 hp), grade A/B/C/D/E/Fx/F
Additional points on the exam from home excercises are only valid until the next years course starts.

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.