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Basic Information:
Course Title: Superconductivity: basics and aplications
Lecturer: assoc. prof. Krastyo Buchkov, PhD
Phone: +359899400334
Email: buchkov@issp.bas.bg
Total Teaching Hours: 30

Annotation (up to 150 words)
This course provides an introductory overview of superconductivity, superconducting materials, and their application. The main topics include phenomenological basics and critical parameters, materials and their preparation in various structural forms. The emphasis of the course is related to electrodynamics of type II superconductors, high-power applications, and superconducting (quantum) electronics. The course outline is developed for young researchers and PhD students with interest in condensed matter physics and materials science.

Course content (brief description by topics or modules)
Synopsis:
Module 1: Basics of Superconductivity

Topic 1: Introduction to Superconductivity and course overview.
Topic 2: Basic physical properties of superconductors.
Topic 3: Phenomenological theories – London equations and Ginzburg – Landau theory.
Topic 4: Electronic structure and superconductivity physical mechanisms.
Topic 5: Conventional and unconventional superconducting materials.
Topic 6: Josephson effect.
Topic 7: Electrodynamics of superconductors (part I):
- Type I and II superconductors.
Topic 8: Electrodynamics of superconductors (part II):
- vortex matter and dynamical processes.
Topic 9: Synthesis and preparation of superconducting materials in various structural forms:
- bulk materials and nanostructures.
Topic 10: Open questions and modern research topics.

Module 2: Superconductivity practical applications

Topic 11: High power applications: conductors, electromagnets, electric machines and levitation devices
Topic 12: Superconducting electronics and quantum technologies based on the Josephson effect.

Module 3: Low temperature physics basics and cryogenics. Resistive experiments for investigation of superconducting samples. Magnetic levitation and effect of Meissner.

Teaching and assessment methods
The course will be conducted in presentational lecture panels and discussions - individually or for a small group. The evaluation (passed/not passed) will be based also on presentation of selected topics from the course depending on the research interests of the participants.

Competencies acquired as a result of training (3–5 points)
Acquiring knowledge for Superconductivity phenomenological basics.
Basic knowledge of the technological principles for practical applications:
- modern quantum technologies
- high power applications

Literature:
[1] Tinkham, Michael. *Introduction to superconductivity*. Courier Corporation, 2004.
[2] Buckel, Werner, and Reinhold Kleiner. *Superconductivity: fundamentals and applications.* John Wiley & Sons, 2008.
[3] Contemporary review articles focused on the main research trends in the field of Superconductivity (provided by the lecturer).

Additional information (optional) (e.g., special requirements, laboratory equipment, prior knowledge)
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