PHYS-476

Advanced superconducting magnet technologies

Riccioli Rebecca

Cursus	Sem.	Type
Ing.-phys	MA2, MA4	Opt.
Physicien	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The course will focus on the technologies related to the practical use of superconductors, from the manufacturing to their exploitation. The course also provides some examples of the use of superconductivity for relevant applications and the main technological challenges related to each of them.

Content

Theoretical part
Introduction to indistrial superconductors
Fundamental Principles of Superconducting Magnets
Coil design and manufacturing (Lecture on cables by Dr. Kamil Sedlak)
Cooling techniques and thermal management
Superconducting magnet applications:

- Accelerators
- Particle therapy
- Nuclear fusion (Lecture by Dr. Kamil Sedlak)
- Motors

Field quality measurements (Lecture by Dr. Giuseppe Montenero)

Exercises and laboratories
Practical exercises on 0D design of TOKAMAK coils, solenoid and dipole magnet. (Dr Daniel Biek)
Laboratory activity on the measurement of the critical temperature

Keywords

Superconductivity
Magnets
Field quality

Learning Prerequisites

Required courses

Advanced physics II PHYS-105
Physics lab (metrology) PHYS-117
Classical electrodynamics PHYS-324
Solid state physics PHYS-337

Recommended courses

Solid state physics III PHYS-419
Solid state physics IV PHYS-420
Fundamentals of biomedical imaging PHYS-438
Nuclear fusion and plasma physics PHYS-445
Introduction to particle acceleratos PHYS-448
MRI practicals on CIBM preclinical imaging systems PHYS-473

Learning Outcomes

By the end of the course, the student must be able to:

- Design electromagnetically simple magnet geometries
- Define the working points of the superconductor based on the application
- Formulate the critical aspects of a superconducting magnet
- Describe the different systems to characterize the magnet quality
- Expound the main aspects of superconducting magnets for different applications

Transversal skills

- Demonstrate the capacity for critical thinking
- Use both general and domain specific IT resources and tools
- Write a scientific or technical report.

Teaching methods

Lecture based teaching using slides and blackboard.

Assessment methods

The exam is based on an oral assessment during the exam session. Before the oral exam, students will be asked to write a short report describing the laboratory activities completed, which will contribute 10% of the final grade.

Supervision

Office hours	Yes
Assistant.e.s	No
Forum	No
Others	The office hours will take place via zoom. In order to have a discussion with the teacher send an email with the convinient time and dates for the students.

Resources

Bibliography

M. Wilson, "Superconducting Magnets", Clarendon Press Oxford, New York, 1982
CAS (CERN Accelerator School), "Magnetic Measurement and Alignment", Geneva, 1992
Y. Iwasa, "Case Studies in Superconducting magnets", Plenum Press, 1994
P. Tixador, "Les supraconducteurs", Hermes, Paris, 1995
Werner Buckel, Reinhold Kleiner, "Superconductivity: Fundamentals and Applications", Wiley-VCH Verlag GmbH & Co. KGaA, 2004
G. Krabbes, et al. , "High Temperature Superconductor Bulk Materials", Wiley-VCH, 2006
Stephan Russenschuck, "Field Computation for Accelerator Magnets", Wiley-VCH Verlag GmbH & Co. KGaA, 2010

Ressources en bibliothèque

- Find the references at the Library

Références suggérées par la bibliothèque

- Magnetic Measurement and Alignment / CAS (CERN Accelerator School)

Moodle Link

- https://go.epfl.ch/PHYS-476