PHYS-419 **Solid state physics III**

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Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.
Quantum Science and Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	6
Session	Winter
Semester	Fall
Exam	Oral
Workload	180h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	2 weekly
Number of positions	

Summary

The aim of this course is to provide an introduction to the theory of a few remarkable phenomena of modern condensed matter physics ranging from the quantum Hall effects to superconductivity.

Content

Magnetism of insulators

- Review of band theory
- Mott insulators and Hubbard model
- Heisenberg model
- Spin-wave theory of ferromagnets and antiferromagnets

Orbital magnetism of metals and semiconductors

- Landau levels
- De Haas-Van Alphen and Shubnikov-de Haas oscillations
- 2D electron gas: Integer and fractional Quantum Hall effects

Theory of superconductivity

- Electron-phonon interaction
- BCS theory
- Landau-Ginsburg theory
- Flux quantization and Josephson effect

Learning Prerequisites

Recommended courses

Good grasp of quantum mechanics and solid state physics say at the level of *"Lectures on quantum mechanics"* by Gordon Baym and *"Solid state physics"* by Ashcroft and Mermin

Learning Outcomes

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

- Explore the quantum properties of solids and synthetic many body systems

Transversal skills

- Access and evaluate appropriate sources of information.
- Continue to work through difficulties or initial failure to find optimal solutions.

Teaching methods

Ex cathedra. Exercises in class

Assessment methods

40% assessed homework, 60% oral exam

Resources

Bibliography

Lecture notes

Prerequisite for

Solid state physics IV