

PHYS-419

**Solid state physics III**

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Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Oral
Workload	150h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

The aim of this course is to provide an introduction to the theory of a few remarkable phenomena of 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

**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**

oral exam

### **Resources**

#### **Bibliography**

Lecture notes

### **Prerequisite for**

Solid state physics IV