

PHYS-433

**Semiconductor physics and fundamentals of electronic devices**

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA1, MA3	Opt.
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

Series of lectures encompassing the fundamentals of semiconductors and the description of the main microelectronic devices built from semiconductors going from the p-n junction to the MOSFETs, which are at the heart of the CMOS-technology with an emphasis on downscaling issues.

**Content****1. Electronic properties of semiconductors**

- Crystalline structures and energy band diagrams
- Impurities and doping
- Carrier statistics in equilibrium and out-of-equilibrium
- Electron transport in weak and strong fields
- Generation and recombination processes

**2. Theory of junctions and interfaces**

- p-n and metal-semiconductor junctions
- Oxide-semiconductor and heterojunction interfaces
- Principles of bipolar transistor operation

**3. Field effect devices**

- MESFET, MOSFET and HEMT transistors
- Downscaling principles
- Submicron devices

**Learning Prerequisites****Recommended courses**

Introduction Solid State Physics

**Learning Outcomes**

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

- Argue
- Contextualise
- Sketch
- Synthesize
- Generalize
- Structure
- Propose

- Assess / Evaluate

### Transversal skills

- Use a work methodology appropriate to the task.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Take feedback (critique) and respond in an appropriate manner.
- Communicate effectively with professionals from other disciplines.

### Teaching methods

Ex cathedra with exercises

### Expected student activities

Read the bibliographical resources in order to fully integrate and properly use the physical concepts seen in the lectures and the exercises

Be able to generalize the above-mentioned concepts to a wide variety of systems/devices

### Assessment methods

written exam (100%)

### Resources

#### Bibliography

S. M. Sze, "Physics of semiconductor devices" 2nd edition (John Wiley & Sons, New York, 1981)

P. Y. Yu & M. Cardona, "Fundamentals of Semiconductors, Physics and Materials Properties" 2nd edition (ou > 2nd ed.) (Springer, Berlin, 1999)

N. W. Ashcroft and N. D. Mermin, "Solid State Physics" (Saunders College Publishing, Fort Worth, 1976)

#### Ressources en bibliothèque

- [Fundamentals of Semiconductors / Yu](#)
- [Physics of semiconductor devices / Sze](#)
- [Solid State Physics / Ashcroft](#)