

EE-433

**Hardware systems modeling II**

Vachoux Alain

Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Mineur STAS Chine	E	Opt.

Language of teaching	English
Credits	2
Session	Summer
Semester	Spring
Exam	Written
Workload	60h
Weeks	14
<b>Hours</b>	<b>2 weekly</b>
Courses	2 weekly
<b>Number of positions</b>	

**Summary**

Creation and use of models of analog and mixed-signal hardware systems at various levels of abstraction. Use of the VHDL-AMS hardware description language.

**Content****Introduction**

Models in electronic mixed-signal design automation. Mixed-signal hardware description languages. Analog and mixed-signal simulation techniques.

**The VHDL-AMS language**

VHDL-AMS characteristics (language, design flow, modeling guidelines). VHDL-AMS model organization. Behavioural and structural VHDL-AMS modeling.

**Modeling of analog and RF components**

Electrical primitives. Operational amplifier, OTA. Filters. RF building blocks. Use of discrete-event modeling techniques. Testbenches and verification techniques.

**Modeling of mixed-signal components**

A/D and D/A interfaces. A/D and D/A converters. Testbenches and verification techniques.

**Keywords**

Mixed-signal system, continuous-time model, behavioral modeling, VHDL-AMS.

**Learning Prerequisites****Required courses**

Hardware systems modeling I (EE-432).

**Recommended courses**

Digital systems design (EE-334).

**Important concepts to start the course**

VHDL modeling. Circuits and systems.

**Learning Outcomes**

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

- Exploit mixed-signal modeling techniques.
- Develop reusable models at various levels of abstraction.
- Produce quality and reusable VHDL-AMS models.

## Teaching methods

Lecture with integrated exercises.

## Expected student activities

Attending lectures. Completing exercises. Use of state-of-the-art electronic design automation (EDA) tools.

## Assessment methods

Homework exercises. Midterm project. Final examination.

## Supervision

Office hours	No
Assistants	Yes
Forum	Yes
Others	Individual feedback comments on delivered work in the Moodle page of the course.

## Resources

### Bibliography

P. Ashenden, G. Peterson, and D. Teegarden, *The System Designer's Guide to VHDL-AMS*, Morgan Kaufmann, 2002.

R. Frevert, J. Haase, R. Jancke, U. Knöchel, P. Schwarz, R. Kakerow, and M. Darianian, *Modeling and simulation for RF system design*, Springer, 2005.

F. Pêcheux, C. Lallement, and A. Vachoux, *VHDL-AMS and Verilog-AMS as alternative hardware description languages for efficient modeling of multidiscipline systems*, IEEE Trans. on Computer-Aided Design of Integrated Circuits and Systems, vol. 24, pp. 204-225, 2005.

### Ressources en bibliothèque

- [Modeling and simulation for RF system design / Frevert](#)
- [The System Designer's Guide to VHDL-AMS / Ashenden](#)
- [VHDL-AMS and Verilog-AMS / Pêcheux](#)

### Notes/Handbook

Lecture notes, VHDL-AMS syntax summary.

### Websites

- <http://en.wikipedia.org/wiki/VHDL-AMS>
- <http://www.eda.org/twiki/bin/view.cgi/P10761/WebHome>

### Moodle Link

- <http://moodle.epfl.ch/course/view.php?id=233>