

# Automatique



## Component

École Nationale  
Supérieure  
d'Électrotechnique  
d'Électronique  
d'Informatique  
d'Hydraulique  
et des  
Télécommunications

## In brief

- > **plugin.odf-inp:PLUGINS\_ODF\_COURSE\_NBHOURS\_TXT:** 5 lectures + 4 tutorials + 5 practical sessions + 1 exam + 1 BE
- > **Ametys Code:** N5EN05B
- > **Open to exchange students:** No

## Presentation

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### Objectives

This course aims to bridge the gap between computer science and system engineering by providing students with a comprehensive understanding of controlled physical systems and their computational processing. Recognizing the often challenging communication between software engineers and domain-specific engineering specialists, the course offers a unified framework for modeling, analyzing, and controlling complex systems. By the end of the course, students will acquire essential skills across the entire processing chain, modeling, design, simulation, and deployment, grounded in a solid mathematical foundation rooted in control theory and ordinary differential equations. This includes developing system simulations, collecting and analyzing sensing data, performing state estimation, designing and optimizing state feedback control strategies, and implementing these solutions on realistic embedded hardware, i.e Robot Lego MindStorm. Through this integrated approach, students will develop both practical skills and theoretical insights, equipping them for effective interdisciplinary collaboration and innovative system control.

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### Description

The course outline is as follows:

- Introduction, examples of controlled systems;
- Mathematical notation of a controlled system;

- Stability of dynamic systems;
- State feedback control of systems;
- Introduction to block diagram modeling in MatLab Simulink;
- Implementation on a Lego Mindstorm robot representing a "SegWay" of a state feedback controller stabilizing the system.

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## Pre-requisites

Differential equations, imperative programming, C Language, fundamentals of architecture and operating systems.

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## Bibliography

- [1] Morris W. Hirsh and Stephen Smale. Differential Equations, Dynamical Systems, and Linear Algebra. Pure and Applied Mathematics. Academic Press, 1974.
- [2] Frédéric Jean. Stabilité et Commande des Systèmes Dynamiques. Cours et exercices corrigés. Coll. Les Cours, Les Presses de l'ENSTA, 200 pages, nov. 2011.
- [3] Gergaud Joseph. Cours polycopié d'équations différentielles ordinaires. 2016.
- [4] Eduardo D. Sontag. Mathematical Control Theory : Deterministic Finite Dimensional Systems. Number 6 in Textbooks in Applied Mathematics. Springer-Verlag, second edition, 1998.
- [5] C. Wagschal. Dérivation, Intégration. Hermann, 1999.

## Useful info