# UE Project management and seminars

Level
Baccalaureate +5

ECTS
3 credits

Component
UFR PhITEM (physique, ingénierie, terre, environnement, mécanique)

Semester
Printemps

- **Teaching language(s):** English
- **Open to exchange students:** Yes
- **Code d'export Apogée:** PAXXSCAB

# Presentation

## Description

### Project management (10.5 h)

The objectives of this class are to supply the bases of the project management as well as to present the good practices in industries. The quality management according to the standards ISO and the piloting by process are presented through industrial projects.

This class contains a method to establish a CV as well as simulations of real recruitment interview.Class schedule

| Lesson | Topic |
|---|---|
| 1 | **History** |
| | *The contributions of the management by project; implementation of management by project in the development of products and in big projects management; notion of risk analysis.* |
| 2 | **Management of project** |
| | *Role of the project manager and the team project; piloting of the expertise within the projects; milestone, points of meeting* |

| | |
|---|---|
| | *in the crossroads of the professions; economic management; management of the resources, the planning of the works by resource; follow-up of the expenses (material and human).* |
| | Put into practice: study of concrete cases, how to start a schedule, notion of task and decomposition by task. |
| 3 | **Quality management** |
| | *ISO 9001 standard and AFAQ; why a quality management within most of the biggest companies; notion of process quality; piloting a company by quality processes and quality plan; projects life cycle, role of the quality control managers.* |
| 4 | **Put into practice** |
| | *A company program quality (development of products and business management).* |
| 5 | **CV & recruitment interview** |
| | *most significant key points to establish a "sticker" CV; prohibitions; hangs on it on an announcement; CV Draft and personalized CV.*<br>*CV workshop: Recruitment interview* |
| 6 | **CV workshop: Recruitment interview** |

## Industrial seminars (27 h for IPA)

- Semi-active damper design and regulation. B. TALON, *SOBEN*.
- Model-based design for motor control. V. TALON, *Renault*.
- Case study on warm compression station for cryogenics. B. BRADU, *CERN* .
- Keys and social issues to enter the industrial life. M. PRUNIER, *Schneider*.
- Consulting for inovation in Information Technologies. D. JACQUET, *Protoptim* .

## Research seminars (15 h for CST)

Each year, MiSCIT and GIPSA-lab invite keynote speakers to give a short class on their research topic. The lectures (typically 15h) are given in the Control Systems Department of GIPSA-lab. They focus on the latest results in a specific topic of control and systems theory, and may include some labs to illustrate specific aspects. The attendance is composed as Master and Ph.D. students, as well as engineers, researchers and professors. A basic knowledge in dynamical systems, linear algebra and control theory is expected.

## Linear Matrix Inequalities and Sum-of-Squares Optimization in Systems and Controls Theory: A Practical and Theoretical Overview (2013)

By *Mattew M. Peet*, Professor of Aerospace Engineering, Arizona State University (USA)

**Abstract:** The topic of this course will be the use of LMI methods for optimal control of linear, nonlinear and infinite-dimensional systems. We will start by posing all major finite-dimensional optimal control problems as LMIs. This includes both output and full-state feedback control for both the H_\infty and H_2 (LQG) system norms. We will also give a brief introduction to the popular SDP solver SeDuMi. Next, we will give a background on the use of LMIs for optimization of polynomial variables such as in the Sum-of-Squares framework - including the use of the Matlab toolbox SOSTOOLS. We will discuss several theoretical tools for the optimization of polynomials such as various versions of the Positivstellensatz. Finally, we will discuss how LMIs and polynomial optimization have been use to resolve long-standing problems in analysis of nonlinear systems and systems with delay, and how these results have been extended to synthesize optimal controllers for systems with delay and certain classes of partial-differential equations.

**Syllabus:**

- *Day 1*: Convex optimization; Semidefinite programming; Linear state-space systems theory; Optimal H_2 and H_\infty dynamic output-feedback controller synthesis.
- *Day 2*: Polynomial optimization, Sum-of-Squares; Polya's lemma; Ideals, Varieties; The Positivstellensatz; Robust controller synthesis
- *Day 3*: Nonlinear stability analysis; Analysis and control of linear delayed systems; Analysis and control of linear partial-differential equations; Stability Analysis of nonlinear delayed and partial-differential equations.

## Model Reduction (Approximation) of Large-Scale Systems (2012)

By *Charles Poussot-Vassal*, Researcher at Onera - The French Aerospace Lab.

**Abstract:** In the engineering area (e.g. aerospace, automotive, biology, circuits), dynamical systems are the basic framework used for modelling, controlling and analysing a large variety of systems and phenomena. Due to the increasing use of dedicated computer-based modelling design software, numerical simulation turns to be more and more used to simulate a complex system or phenomenon and shorten both development time and cost. However, the need of an enhanced model accuracy inevitably leads to an increasing number of variables and resources to manage at the price of a high numerical cost. This counterpart is the justification for model reduction (see Figure 1).
The objective of the lecture is to introduce the model reduction (or approximation) problem, within the linear framework only, and, in an increase complexity, some of the well established and modern techniques to solve this class of problem. The lecture is also coupled with two Matlab-based labs, in order to emphasize the numerical difficulties and to provide the participant an insight of the existing tools.

**Syllabus:**

- *Day 1*: Introduction, motivating examples and model reduction problem; Overview of the approximation methods and linear algebra tools; Gramian and SVD based techniques; Moment matching and Krylov subspace based techniques.
- *Day 2*: Lab 1, Application of the SVD techniques and the Arnoldi procedure; H2 first order optimality conditions, generalized Krylov subspace and Tangential techniques; Advanced techniques (Mixed and Sylvester approaches / Multi-LTI and LPV problems / Tools).
- *Day 3*: Lab 2, Krylov based techniques and MORE Toolbox (developed within Onera by C. Poussot-Vassal).

## Design Projects: analysis (15 h)

Under Floor Air Distribution for Intelligent Buildings

This new technology presents many advantages in comparison with traditional ventilation systems, such as energy consumption reduction, comfort and health. UFAD efficiency directly depends on distributed sensing capabilities (thanks to the deployment of a wireless sensor network) and on an appropriate multivariable feedback control design. The idea comes then to conceive a prototype in order to validate theoric and simulation results and to implement control algorithms. The prototype represents a ventilated floor composed of three interconnected levels: under floor, four rooms and upper floor. The related IPA projects are dedicated to air conditioning operation, with an emphasis on the modeling and control of airflow in each level and between the adjacent rooms. Controlling instability: the inverted half cube

Unstable processes are typically not controllable with open-loop strategies and hence provide valuable benchmarks for feedback control applications. Addressing the stabilization of such processes implies a specific care of the key control design issues, such as performance limitations, communication and computation constraints, robustness, nonlinearities etc.
The inverted half cube, designed and built by IPA students, implies to stabilize the half cube on its lower edge thanks to a cart driven with a LEGO NXT module. This novel version of the classical "inverted pendulum" implies to solve the same control problems as those associated with walking biped robots, a missile propelled by a jet reaction, a load suspended from a crane, etc...

## Course parts

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|---|---|---|
| UE Project management and seminars - CM | Lectures (CM) | 25,5h |
| UE Project management and seminars - TD | Tutorials (TD) | 60h |

**Period :** Semester 10

# Useful info

## Place

Grenoble

## Campus

Grenoble - Scientific Polygon