

PHYS-442

**Modeling and design of experiments**

Fuerbringer Jean-Marie

Cursus	Sem.	Type
Ing.-phys	MA2, MA4	Opt.
Physicien	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
TP	2 weekly
<b>Number of positions</b>	

**Summary**

In the academic or industrial world, to optimize a system, it is necessary to establish strategies for the experimental approach. The DOE allows you to choose the best set of measurement points to minimize the variance of the results. The concepts learned are applicable in all areas.

**Content**

- Fundamentals of DOE theory
- Multilinear regression
- Greco-Latin squares
- Plackett-Burman designs
- Factorial and fractional factorial designs
- Surface response designs
- Mixture designs

**Keywords**

Design of experiments, ANOVA, Least square fit, Statistics, Multilinear regression, variance minimization

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

Statistics, metrology

**Important concepts to start the course**

Basic statistical concepts such as average, variance, statistical distributions, Calculus, linear algebra matriciel, Matlab or Python fundamentals, coding fundamentals

**Learning Outcomes**

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

- Propose an empirical model in function of the experimental objective
- Analyze an experimental situation and identify the critical elements from a statistical point of view
- Establish a design of experiments in relation with the candidate models and the experimental constraints

### Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Use a work methodology appropriate to the task.
- Demonstrate the capacity for critical thinking
- Use both general and domain specific IT resources and tools

### Teaching methods

Theoretical presentation, cases calculation and analysis

### Expected student activities

- Synthesized the theoretical presentation in personal summary with concept maps
- Solve exercise problems

### Assessment methods

Oral exam consisting in solving and analyzing a case

### Resources

#### Bibliography

- Box, G.E.P.; Hunter, J.S.; Hunter, W.G. Statistics for Experimenters; Wiley Series in Probability and Mathematical Statistics, John Wiley and Son, 1978.
- Montgomery, D.C. Design and analysis of experiments, 7th edition ed.; John Wiley and Son, 2009.
- Davison A.C.; Statistical model, Cambridge University Press in June 2003.
- Ryan Th.; Modern Experimental Design, John Wiley and Son, 2007.

#### Ressources en bibliothèque

- [Modern Experimental Design](#)
- [Statistical model](#)
- [Design and analysis of experiments](#)
- [Statistics for Experimenters, An introduction to design, data analysis and model building](#)

#### Moodle Link

- <https://go.epfl.ch/PHYS-442>