

**Module Description, available in: EN**

## Stochastic Modeling

**General Information****Number of ECTS Credits**

3

**Module code**

FTP\_StochMod

**Valid for academic year**

2024-25

**Last modification**

2020-04-01

**Coordinator of the module**

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**Explanations regarding the language definitions for each location:**

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

|                      | Lausanne |  |  | Lugano | Zurich   |  |  |
|----------------------|----------|--|--|--------|----------|--|--|
| <b>Instruction</b>   |          |  |  |        | X E 100% |  |  |
| <b>Documentation</b> |          |  |  |        | X E 100% |  |  |
| <b>Examination</b>   |          |  |  |        | X E 100% |  |  |

**Module Category**

FTP Fundamental theoretical principles

**Lessons**

2 lecture periods and 1 tutorial period per week

**Entry level competences****Prerequisites, previous knowledge**

1. Basis calculus (integration, differentiation, ordinary differential equations, complex numbers, Fourier transform)
2. Basic probability theory (probability, conditional probability, Bayes' theorem, expectation, variance, random variables)
3. Linear algebra (matrix algebra, system of linear equations, eigenvectors, eigenvalues)

**Brief course description of module objectives and content**

The ubiquitous presence of uncertainty and noise in the engineering sciences and the importance of randomized algorithms in computer and data science make it mandatory to understand and quantify random phenomena. To achieve this goal the course will provide a solid review of probability theory and an introduction to the theory of stochastic processes. Special attention is given to applications, including examples from various fields such as communications and vision, signal processing and control, queuing theory or physics of small systems (Brownian motion).

## Aims, content, methods

### Learning objectives and acquired competencies

The student is familiar with the main working tools and concepts of stochastic modeling (expectation, variance, covariance, autocorrelation, power spectral density). He/She is able to explain properties and limitations of stochastic processes as a modeling tool for noisy systems. He/She will be able to model and analyze simple random phenomena through adaptation of proposed stochastic models.

### Contents of module with emphasis on teaching content

- Probability review: random variables, conditional probabilities, theorem of large numbers, central limit theorem.
- General introduction to discrete and continuous stochastic processes. Applications, e.g., communications, Kalman filtering.
- Discrete, continuous and hidden Markov chains. Applications, e.g., page rank algorithm, queuing systems, pattern recognition, speech recognition.
- Bernoulli, Poisson, Gaussian processes, Brownian motion, white and colored noise.

### Teaching and learning methods

Ex cathedra teaching

Presentation of simulation results and case studies

### Literature

The script is, in principle, sufficient. Further readings are:

1. Sheldon M. Ross, Probability Models, Elsevier.
2. John A. Gubner, Probability and Random Processes for Electrical and Computer Engineers, Cambridge University Press.
3. Mario Lefebvre, Applied Stochastic Processes, Springer.
4. Bassel Solaiman, Processus stochastiques pour l'ingénieur, PPUR.

## Assessment

### Certification requirements

Module does not use certification requirements

### Basic principle for exams

**As a rule, all the standard final exams for modules and also all resit exams are to be in written form**

### Standard final exam for a module and written resit exam

Kind of exam

written

Duration of exam

120 minutes

Permissible aids

*Aids permitted as specified below:*

Permissible electronic aids

No electronic aids permitted

Other permissible aids

Handwritten summary of five A4 sheets (=ten pages in total), compiled by the student.

### Special case: Resit exam as oral exam

Kind of exam

oral

Duration of exam

30 minutes

Permissible aids

No aids permitted