MASTER OF SCIENCE IN ENGINEERING

Module Description

Stochastic Modelling

General Information

Number of ECTS Credits

3

Module code

FTP_StochMod

Responsible of module

Roger Filliger, BFH

Language

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.

	Berne	Lausanne			Lugano	Zurich		
Instruction	☐ E 100%	✶E 100%		☐ F 100%	☐ E 100%	✶ E 100%		☐ D 100%
Documentation	☐ E 100%	✶E 100%	☐ E %	☐ F %	☐ E 100%	✶ E 100%	☐ E %	☐ D %
Examination	☐ E 100%	✶E 100%	☐ E 100%	☐ F 100%	☐ E 100%	✶ E 100%	☐ E 100%	☐ D 100%

Module category

✶ FTP Fundamental theoretical principles

☐ TSM Technical/scientific specialization module

☐ CM Context module

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competencies

Prerequisites, previous knowledge

1. Basis calculus (integration, differentiation, ordinary differential equations, complex numbers, Fourier transform)
2. Basic probability theory (probability, conditional probability, expectation, variance, random variable)
3. Linear algebra (matrix algebra, eigenvalues)

Brief course description of module objectives and content

The ubiquitous presence of uncertainty and noise in the engineering sciences makes it mandatory to understand and quantify random phenomena. To achieve this goal the course will provide a solid introduction to the theory of stochastic processes. Special attention is given to applications. The applications include examples from various fields such as communications and vision, signal processing and control, production and traffic flows, queuing theory, financial market and 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 modelling (expectation, variance, covariance, autocorrelation, power spectral density). He/She is able to explain properties and limitations of stochastic processes (mainly Markov processes) as a modelling 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: communications, Kalman filtering.
- Discrete, continuous and hidden Markov Chains. Applications: stochastic manufacturing systems, queuing systems, pattern recognition, speech recognition.
- Bernoulli, Poisson, Gaussian Processes, Brownian motion, white and coloured 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 for final examinations (conditions for attestation)

non

Basic principle for exams:
All the standard final exams for modules are written exams.
The repetition exams can be either written or oral.

Standard final exam for a module and written repetition exam

Kind of Exam	written
Duration of exam	120 minutes
Permissible aids	☐ no aids
	✶ permissible aids:
	✶ Electronical aids: CAS calculator (no access to internet)
	✶ Hardcopy form: no limitations
	✶ Autonomous work, no communication during exam

Special case: Repetition exam as an oral exam

If an oral exam is set (only possible for ≤ 4 students), the following applies:

Kind of Exam	oral
Duration of exam	30 minutes
Permissible aids	no aids