Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

# Course catalogue

*Page compiled on 21/08/2019*

## Programme of Course "Stochastic Processes"

- Code: DT0052
- Type of course unit: Elective (Master Degree in Mathematics curriculum Generale), Elective (Master Degree in Mathematical Engineering curriculum Comune)
- Level of course unit: Postgraduate Degrees
- Semester: 2

Number of ects credits: (Master Degree in Mathematical Engineering) 6 (workload 150 hours), (Master Degree in Mathematics) 6 (workload 150 hours)

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| 1 | **Course objectives** | The course aims to give an introduction to the theory of stochastic processes with special emphasis on applications and examples. On successful completion of this module the students should become familiar with some of the most known classes of stochastic processes (such as martingales, markov processes, diffusion processes) and to acquire both the mathematical tools and intuition for being able to describe systems with randomness evolving in time in terms of a probability model and to analyze it charcterizing some of its properties |
| 2 | **Course content and learning outcomes (dublin descriptors)** | Topics of the module include:<br>• Stochastic Processes: definition, finite dimensional distributions, stationarity, sample path spaces, construction, examples<br>• Filtrations, stopping times, conditional expectation.<br>• Markov processes: definition, main properties and examples. Birth and death processes.<br>• Poisson process with applications on queueing models.<br>• Martingales: definition, main properties and examples.<br>• Brownian motion: definition, construction and main properties.<br>• Brownian Bridge, Geometric Brownian Motion, Ornstein-Uhlenbeck process.<br>• Ito integral and stochastic differential equations. Applications and examples<br><br>On successful completion of this module, the student should :<br>• have knowledge of language, basic concepts and techniques of the Theory of stochastic processes, have knowledge and understanding of some relevant classes of processes (Markov processes, Martingales, Diffusions) and their properties, have knowledge and understanding of tha main mathematical tools and results on Stochastic calculus and be aware of its potential applications<br>• be able to identify, analyse and prove relevant properties of models based on stochastic processes, be able to solve problems related to such models<br>• evaluate the possible approaches to modeling a system with randomness using a stochastic process, be able to select the most appropriate one, to discuss its fundamental futures and to compare it with other models<br>• demonstrate ability to describe complex systems and problems in a probabilistic way, explain them in terms of stochastic dynamics, to illustrate and give rigorous proofs of their main features<br>• demonstrate capacity for reading and understanding texts and research papers on related topics |
| 3 | **Course prerequisites** | Probability theory (probability spaces, conditional probability, independence, product spaces, random variables and their distributions, expectation, convergence, limit theorems for sequences of random variables), real analysis, basics on measure theory and Lebesgue integral, basics on discrete times markov chains |
| 4 | **Teaching methodsand language** | Lectures and exercises<br>**Language**: English<br>**Reference textbooks**<br>• J. Rosenthal, ***A first look at Rigorous Probability Theory***. World Scientific.<br>• Z. Brzezniak and T. Zastawniak, ***Basic Stochastic Processes, A Course Through*** |

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| | | ***Exercises***. Springer.<br>• G. Lawler, ***Introduction to Stochastic Processes***. Chapman & Hall.<br>• G. Grimmett, D. Stirzaker, ***Probability and random Processes***. Oxford University Press.<br>• B. Oksendal, ***Stochastic Differential Equations***. Springer-Verlag . |
| **5** | **Assessment methods** | Written and oral exam. |