T-811-PROB **APPLIED PROBABILITY** **8 ECTS**

Year:	First year MSc.
Semester:	Fall.
Level of the course:	5. Second cycle, intermediate.
Course type:	Core for MSc Engineering Management and MSc Financial Engineering.
Prerequisites:	Probability and Stochastic Processes (T-606-PROB).
Schedule:	Runs for 12 weeks- 6 teaching hours a week.
Supervisor:	Heiðar Ingvi Eyjólfsson.
Teacher:	Heiðar Ingvi Eyjólfsson.

Learning outcomes: This course will cover some important topics in probability theory with particular emphasis on their application to practical problems. At the end of the course the student will have an appreciation of the important role probability plays in various areas of engineering and be able to apply it to a range of concrete real-world problems. This learning outcome can be broken down into the following sub outcomes:

- Understand the basic concepts of probability distributions and their role in the modelling of uncertain outcomes – both in the discrete and the continuous case
- Use expectation, variance and covariance to model various probabilistic phenomena
- Apply conditional probabilities and Bayes's formula to events in the presence of partial information
- Understand jointly distributed random variables and functions of random variables
- Understand the theoretical basis of moment generating functions and their application to the construction of probability distribution functions
- Understand the theoretical basis of the limit theorems, the law of large numbers and important inequalities
- Understand the role of probability in Reliability applications
- Understand Poisson processes, birth and death processes and Markov processes and their roles in the modelling of queues
- Understand different types of queues and their classification
- Be able to estimate the performance of different queueing systems in terms of quantities such as, queue length, expected waiting time or the probability of system blockage
- Understand the role of stochastic processes in financial applications

Content: This course will start by recalling some basic concepts in probability theory. Important discrete and continuous probability distributions will be introduced and applied to concrete problems. The concepts of expectations, variances and covariances will be introduced and applied to selected problems. The importance of the theorem of large numbers, central limit theorem and the consequences of these will be introduced. Markov chains will be discussed as well as Poisson and death – birth processes with several applications, including queueing theory. Basic stochastic processes such as Brownian motion and Wiener processes and their important role in the modelling and management of uncertainty will be discussed. Throughout the course examples and applications to various practical problems will be considered.

Reading material: Lecture notes will be handed out. Main book: Sheldon M. Ross, *Introduction to Probability Models*, 11th edition, Academic Press, 2014. The following websites contain free online material related to the course content: https://www.probabilitycourse.com/ and http://www.randomservices.org/random/

Teaching and learning activities: Interactive lectures, projects and class exams.
Assessment methods: The final grade will consist of: Student led recitations and assignments 10%; Class exams 30% (best 2 grades out of 3); Final exam 60%.
Language of instruction: English.

All course descriptions may be subject to change. Revised information on the course schedule, reading material, teaching and learning activities, and assessment methods will be introduced in the learning management system Canvas at the beginning of the semester.

Updated May 15th 2020