

Course title:

Probability calculus and elements of stochastic modelling

Duration [number of hours]: **24**

PhD Program [MERC/MPS/SPACE]: **MERC**

Name and Contact details of unit organizer(s):

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Course Description [max 150 words]:

The objective of the course is to provide the students with the fundamentals of probability calculus and (few) elements of stochastic modelling, as well as with their use in the engineering field and science. Starting from the basics of probability theory, the course will cover elements of statistical theory such as point/interval estimation, confidence intervals, hypothesis testing, p-value, as well as elements of stochastic modelling such as commonly-used random variables models, basics of Markov chains, and Poisson processes. The lectures will be much more focused on the application aspects. For this reason, the students are required to form small teams of 2/3 people and work on assignments that will be given throughout the course. The solutions to the assignments will be discussed during the lectures. The assignments will also require the students to work on Matlab (or R, Python, depending on their preference). On successful completion of the course, the students are expected to obtain the necessary knowledge in stochastic and probabilistic models to apply them and develop new methods in the applicative domains of their interest.

Syllabus [itemized list of course topics]:

- Probability: events, axioms, conditional probability, Bayes theorem
- Random variables: discrete and continuous pmf/pdf, common distribution (Bernoulli, Binomial, etc)
- Joint and conditional distributions, conditional expectation
- Law of large numbers, central limit theorem.
- Sampling distribution of mean and variance, point and interval estimation, confidence interval.
- Hypothesis and variance testing: Type I/II errors, p-values, one-way ANOVA.
- Stochastic processes: Poisson, Renewal, gamma, and their engineering applications.

Assessment [form of assessment, e.g., final written/oral exam, solutions of problems during the course, final project to be handed-in, etc.]:

Combined assessment: two in-course assignment (amounting each for 30% each of the final mark), followed by a final exam in the form of a project, amounting for the remaining 40%.

Suggested reading and online resources:

- Ross, Sheldon. *Introduction to Probability Models*. 11th ed. San Diego: Academic Press, 2014.
- Ross, Sheldon. *Stochastic processes*. 2nd Edition. New York, John Wiley & Sons, 1996.