UCLouvain

lepl1108

2023

Discrete mathematics and probability

5.00 credits	30.0 h + 30.0 h	Q1

Teacher(s)	. SOMEBODY ;Delvenne Jean-Charles ;Delvenne Jean-Charles (compensates Pereira Olivier) ;Pereira Olivier ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	This course assumes acquired the basic notion of mathematics (analysis) such as taught in the course **LEPL1102**
Main themes	The course presents the fundamental concepts of discrete mathematics (counting, and graph theory) as well as probabilities necessary for engineering disciplines (random variables, conditional probability, dependence between random variables, estimation and limit theorems).
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 At the end of this course, the student will be able to: - Understand and use basic counting concepts, including using recurrent formulas; - Make the link between the concepts of counting and those of injection, surjection and bijection; - Master the elements of modular arithmetic within the framework of an application, according to the time available - Use the basic concepts of graph theory; - Define, describe, explain and use the concepts of discrete and continuous, univariate and bivariate random variables; - Measure the dependence between two random variables; - Estimate the characteristics of random variables (expectation, variance, covariance, ...), and make the difference between these parameters of the population and their estimation - Use Chebycheff's inequality and limit theorems to characterize random variables - Reformulate the textual statement of a problem in an unambiguous mathematical and probabilistic formalism, using the appropriate theoretical concepts and tools; - Solve an applied problem by following a deductive approach based on the correct and useful manipulation of expressions; - Validate the internal consistency of the formalization and the solution of a probability calculation problem on the basis of the logical constraints induced by the theory.
Evaluation methods	Written exam during the session. An oral examination may also be required, under specific individual circumstances. The assignments (homeworks and mini-projects) during the semester contribute to 20% of the final grade (in January and August), only if it benefits the student. These assignments lead to a unique grade, given after the last assignment. Failure to respect the guidelines explained on Moodle, in particular regarding the use of online resources and/or collaboration between students, for any assignment may lead to a zero grade for the whole assignment grade.
Teaching methods	The course will consist of: - ex cathedra presentations which will present the concepts and tools on the basis of examples from the engineering world; - exercise sessions (APE) aimed at systematically putting into practice the different notions structured during the course. - case studies (APP) which will give the student the opportunity to discover certain notions through problems. Homework and mini-projects may also be offered. Examples related to sustainable development and transition will be evoked.
Content	**Discrete Mathematics:** o Combinatorics and counting o Link between counting and injections, surjections and bijections o Elements of graph theory o Elements of modular arithmetic (including introduction to cryptography or error correcting codes)

	Probabilities o Introduction to statistical data modeling and probability concepts in engineering contexts o Events and probabilities, particularly in relation to combinatorics o Random variables: discrete and continuous (univariate), including pdf and cdf o Examples of random variables: Binomial, Poisson, Gaussian, exponential o Bivariate random variables (discrete and continuous) o Joint distributions, marginal and conditional distributions, independence o Study of the characteristics of uni- and bivariate distributions via simulations on computer o Mean, variance, covariance and correlation, expectation and conditional variance o Introduction to the estimation of these characteristic quantities o Law of Large Numbers and Central Limit Theorem
Inline resources	The Moodle page of the course.
Faculty or entity in charge	BTCI

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Engineering	FSA1BA	5		🔍
Interdisciplinary Advanced Master in Science and Management of the Environment and Sustainable Development	ENVI2MC	5		🔍