Probability

1. **Course number and name:** 020PRBNI4 Probability

2. **Credits and contact hours:** 4 ECTS credits, 2x1:15 contact hours

3. **Name(s) of instructor(s) or course coordinator(s):** Rim Aldbaissy, Rana Fakhreddine, Carine Moussaed, Toni Nicolas, Wafa Saoud, and Diala Wehbe.

4. **Instructional materials: power point** slides; lecture notes; worksheets.
   References:
   - Maths PCSI, X. Oudot et V. Queffelec, Vuibert, 2014.

5. **Specific course information**
   a. **Catalog description:**
      The Probability course enables students to develop an understanding of the probability theory. It is designed to equip students with the necessary skills to effectively calculate probabilities. Throughout this course, students will be introduced to various aspects of probability, beginning with combinatorics. They will learn techniques such as combinations, permutations and arrangements. Furthermore, they will explore concepts that enhance the understanding and manipulation of probabilities on a countable set. This includes the monotone convergence theorem, Boole's inequality, conditioning, compound probabilities, total probabilities and Bayes' formula. Additionally, the course will emphasize the study of discrete random variables, enabling students to model and analyze random phenomena by using probability distributions. Finally, Students explore continuous random variables, with a focus on an extensive examination of cumulative distribution functions, expectation and variance.

   b. **Prerequisites:** 020AA1NI2 Analysis 1

   c. **Required/Selected Elective/Open Elective:** Required

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
      - Understand the concepts of permutation, combination and arrangement, and apply them to solve counting problems.
      - Master the fundamental probabilistic vocabulary, including the concepts of experiments, sample space and events.
      - Familiarize oneself with the monotone convergence theorem and Boole's inequality to manipulate probabilities effectively.
      - Utilize conditioning to calculate conditional probabilities and grasp the notion of independence between events.
      - Study both discrete and continuous random variables, their properties and characteristics.

- Learn about the associated probability distributions, and calculate cumulative distribution functions.
- Understand the concepts of joint distribution for pairs of discrete random variables and determine marginal and conditional distributions.
- Recognize and apply the concept of independence between discrete random variables.
- Calculate the expectation, variance, covariance and standard deviation of a random variable.
- Acquire knowledge of the properties and practical applications of common probability distributions.
- Model random phenomena, and solve probability problems using probability distributions.

b. PI addressed by the course:

PI	1.3	7.1
Covered	x	x
Assessed	x	x

7. Brief list of topics to be covered

- Counting: Permutation, Arrangement, Combination. (2 lectures)
- Probabilistic Vocabulary: Experiment, Sample Space, Events. (1 lecture)
- Probabilistic Space, Monotone Convergence Theorem, Boole's Inequality. (2 lectures)
- Conditioning and Independence. (2 lectures)
- Discrete Random Variables, Probability Distribution, Cumulative Distribution Function. (3 lectures)
- Pairs of Random Variables, Joint Distribution, Marginal Distributions, Conditional Distributions. (3 lectures)
- Independence of Random Variables. (1 lecture)
- Expectation, Variance, Covariance, and Standard Deviation. (3 lectures)
- Common Probability Distributions: Certain Distribution, Uniform Distribution, Bernoulli Distribution, Binomial Distribution, Geometric Distribution, Hypergeometric Distribution, and Poisson Distribution. (2 lectures)
- Continuous Random Variables, Probability Distribution, Cumulative Distribution Function. (2 lectures)
- Expectation, Variance, and Standard Deviation. (1 lecture)
- Common Probability Distributions: Uniform Distribution, Exponential Distribution. (1 lecture)
- Normal Distribution, Standard Normal Distribution. (1 lecture)