Syllabus – Elective Course

Course title:

Mathematical Tools for the Digital Age

Credits:

6 ECTS credits

Teaching language:

English

Target students:

Undergraduate students from all scientific fields with an interest in mathematics and their modern technological applications

Teacher in charge of the course:

Gabriel Chênevert, PhD (ISEN Engineering School, *Université Catholique de Lille*) Special lecturer: Laura Saini, Benoit Pijcke, Benjamin Parent

COURSE PRESENTATION

Prerequisite:

Students undertaking this course should have a basic familiarity with the mathematical concepts of vector, matrices, differentiation, integration, and so forth at the level of a first-year Calculus and Linear Algebra class. They must have some ability to work as a group and be able to communicate easily in English at a standard university level. Some experience with programming (at least one computer science-oriented course) is highly recommended.

Content:

This course will provide students with an overview of a number of today's commodities to underline the mathematical concepts that make them work. Students will review some math notions and apply them to concrete technological tools.

Algorithms are so prevalent around us these days that we often barely notice them, let alone think about how they work. Many of today's commodities rely on deep and interesting mathematical ideas, yet most people would be hard-pressed to explain how the math they learn in school relates in any way to the inner workings of today's technologies.

The goal of this course is to bridge that gap, and allow curious students to gain, in the land of Cauchy and Fourier, an understanding and appreciation of the computations that underlie some applications, in an interactive and hands-on manner.

Class sessions may cover the following topics, depending on student interests:

- GPS geolocalization (solving linear equations)
- Google's PageRank algorithm (Markov chains, graph theory)
- Audio CDs (Shannon's theorem, error correction)

- MP3 files and JPEG images (data compression)
- Camera movement in animation (projective geometry, splines)
- Securing an e-commerce site (cryptography)
- Machine learning (data analysis, optimization)
- Wrap-up and evaluation

Learning Outcomes:

At the end of the course, the students should:

- have some understanding of the breadth and depth of abstract mathematical ideas involved in modern consumer technology, and
- a capacity to understand the inner workings and details of some of these algorithms
- understand how the mathematical models apply to the reality they describe, and
- be able to explore how they behave on computer simulations

WORKLOAD

French contact hours = 60 minutes (in some countries/institutions, 1 contact hour = 45-50 minutes)

Form:	**Number of hours**	**Comments**
Face-to-face, in-class, on-site learning	39 hours	13 sessions of 3 hours
Additional field trips		
Approximate personal work / homework	15 hours	
Student total workload	54 hours	

EDUCATIONAL METHODS

Interactive class, lab, problem solving, presentations, projects, group work, case study

RESOURCES

All course materials will be supplied in class. Reference may be made to the following resource:

C. Rousseau et Y. Saint-Aubin, *Mathématiques et Technologie*, Springer Undergraduate Texts in Mathematics and Technology, 2008.

ASSESSMENT

Form	**Number**	**Duration**	**Comments**
Continuous assessment (20%)	4	20 min	Short quizzes on current material
Final exam (60%)			Computer labs (40%) / Final project (20%)
Others (student participation…) (20%)			Attendance, participation, and contribution to group discussion

This syllabus is based on information available at the time of publication (November 2018). Changes may occur.

For updated information about course content, please contact us: esp@univ-catholille.fr