## Faculty of Applied Sciences

## FSAB1103    Mathematics 3

[30h+30h exercises] 5 credits

This course is taught in the 1st semester

**Teacher(s):**      Vincent Blondel (coord.), Philippe Delsarte, Philippe Delsarte (coord.), Philippe Delsarte (supplée Vincent Blondel), Jean-François Remacle, Grégoire Winckelmans

Language:       French

Level:          First cycle

## Aims

Following this course, the students will be able to :

" Master the fundamental properties of the different types of partial differential equations (PDE): first and second order PDE of linear and quasi-linear type.

" Determine the adequate initial conditions and/or boundary conditions for each type.

" Solve simple PDE using analytical methods.

" Model fundamental physical phenomena governed by PDE; understand the underlying hypotheses and the limitations of the modelisation.

" Master combinatorial reasoning in classical counting subjects; discuss and solve linear recurrences of a simple form.

" Apply fundamental notions of graph theory; to use some algorithms relative to these notions.

" Argue and compute in the domain of discrete structures.

## Main themes

Partial differential equations (3 ECTS)

" Fundamental properties of first and second order PDE and their classification. Links with physics. Illustration of concepts and definitions using examples.

" Initiation to different analytical methods for the resolution of fundamental and simple problems (convection, waves, diffusion, elliptic), to the physical interpretation and to the critical assessment of the results.

Discrete mathematics (2 ECTS)

" Counting methods and linear recurrences. Introduction to graph theory. Study of some fundamental algebraic structures.

" Introduction to certain parts of discrete mathematics, selected according to their educational value and their usefulness in applications. Presentation of the subject in a precise mathematical framework, with numerous illustrative examples.

## Content and teaching methods

Partial differential equations

" Presentation of first and second order PDE: definitions, Cauchy problem and characteristics, classification (hyperbolic, parabolic, elliptic) and link with physics, initial conditions and/or boundary conditions.

" Sturm-Liouville problem and orthogonal functions; development in series.

" Resolution of the Laplace equation in a bounded domain (using separation of variables) and of the Poisson equation in an unbounded domain (using Green's functions).

" Resolution of the wave equation in a bounded domain (using separation of variables) and in an unbounded domain (using characteristics); stationnary wave; wave guide; wave reflexion.

" Resolution of the diffusion equation in a bounded domain (using separation of variables), in a semi-bounded domain (using the similarity variable) and in an unbounded domain (using Green's functions); transient solution and regime solution.

Discrete mathematics

" Counting and recurrences: sets and subsets (binomial numbers); functions and partitions; generating functions; linear recurrences with constant coefficients.

" Algebraic structures: monoids and groups; rings; Boolean functions.

" Graphs: basic notions; connectedness and trees; Eulerian circuits and Hamiltonian cycles; matchings and coverings; optimal paths.

**Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)**

FSAB 1101 Mathématics et FSAB 1102 Mathématics 2

**Other credits in programs**

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| **FSA11BA** | Première année de bachelier en sciences de l'ingénieur, orientation ingénieur civil | (5 credits) | |
| **FSA12BA** | Deuxième année de bachelier en sciences de l'ingénieur, orientation ingénieur civil | (5 credits) | Mandatory |