Compléments de mathématiques et de calcul numérique

Lecturers
Artem NAPOV (Coordinator), Thomas LESSINNES and Jérémie ROLAND

Course mnemonic
MATH-H301

ECTS credits
5 credits

Language(s) of instruction
French

Course period
First term

Campus
Solbosch

Course content

- Ordinary differential equations: power series solutions, orthogonal polynomials and special functions; existence and uniqueness of solutions, Picard's method of successive approximations; integrating factors, integral curves and orthogonal trajectories. First order linear and quasilinear partial differential equations, characteristic curves, Cauchy problems. Representation formula for harmonic functions, Green's function for a Dirichlet problem with Laplace equation. Calculus of variations: Euler's ODE or PDE for an extremal, isoperimetric problems and Lagrange multipliers.
- C syntax (conditions, loops, functions, printing output, pointers, arrays and dynamic memory allocation, pointers to a function, reading/writing files, interaction with FORTRAN-based librairies, interaction with operating system); compiler tools (gnu compilers and their basic options, multiple file managment via gnu make, inspection tools for librairies and executables).

Objectives (and/or specific learning outcomes)

- Go further in the study of real analysis necessary for the physical engineers and develop the ability to understand further mathematical theories when needed. Develop the art of reasoning, elaborate and write down proofs.
- Initiate the students to the aspects of the C programming language which are useful in scientific computiung, as well as to UNIX tools needed to write, compile and execute a code written in C.

Teaching method and learning activities

Mathematics:

Lectures: visual approach with slides for developing a good intuition, together with numerous comments on the notions, the theorems, their proofs, their applications and possible misuses. Exercises assisted by Philippe Gregoire (PhD in Theoretical Physics).

Numerical Computing:

The course starts with 8h of interactive immersion into C programming language; this part is structured around practical examples and is accompanied with few exercises. The students are then invited to do a programming project, and to present and defend this project.

References, bibliography and recommended reading

Mathematics:

W.E. Boyce and R.C. Di Prima: Elementary differential equations and boundary value problems, Wiley, New York, 1991. G.F. Simmons: Differential equations with applications and historical notes, McGraw-Hill, 1972. W.A. Strauss: Partial differential equations, Wiley, New York, 1992. R. Weinstock: Calculus of variations with applications to physics and engineering, Dover, 1994.

Numerical Computing:

B.W. Kernighan et D. M. Ritchie, The C programming language, second edition

(more references are given in the slides of the course)

Course notes

Syllabus, Université virtuelle and Podcast

Other information

Place(s) of teaching

Solbosch

Contact(s)

Anne.Delandtsheer@ulb.ac.be

Artem.Napov@ulb.be (Solbosch campus, *building* D, *office* DB3.141)

Evaluation method(s)

written examination and Project

Evaluation method(s) (additional information)

Mathematics (60%) :

A 4 hours written examination in January, both on theory and exercises. Open questions are posed where the ability of applying

the notions and theorems in a slightly different framework is tested, together with elaborating and writing down careful proofs.

Numerical Computing (40%):

The evaluation is based on the project code, as well as project's presentation and defense

Determination of the mark (including the weighting of partial marks)

- Each of the two parts of the course -- Mathematics and Numerical Computing -- is evaluated with a partial mark
- If the two partial marks are larger than, or equal to, 8/20, the global mark is a weighted arithmetical mean of these two partial marks; the weights are 60% for Mathematics et 40% for Numerical Computing
- If one of the two partial marks is lower than 8/20, the global mark is the minimum of the two partial marks

Main language(s) of evaluation

French

Programmes

Programmes proposing this course at the Brussels School of Engineering

BA-IRCI | Bachelor in Engineering Sciences | option Bruxelles/unit 3