Mathématiques pour la physique

Lecturers
Riccardo ARGURIO (Coordinator), Denis BONHEURE, Clément Cerovecki and Bernard KNAEPEN

Course mnemonic
MATH-F314

ECTS credits
10 credits

Language(s) of instruction
French

Course period
First term

Campus
Plaine

Course content

The course is divided into three parts : numerical methods (48h), group theory (42h) and partial differential equations (30h).

Numerical methods :

Introduction to numerical methods for the resolution of partial differential equations

1. Integration of ordinary differential equations
2. Differentiation by the method of finite difference
3. Resolution of partial differential equations
4. Iterative methods for the inversion of linear equations
5. Spectral methods: Fourier series and Chebyshev polynomials

Group theory :

1. Introduction and motivation
2. Group theory, representations and algebras
3. Rotations: SO(3) and SU(2) groups and algebras
4. Space-time transformations: Lorentz and Poincaré groups

Partial differential equations :

1. Classification of linear partial differential equations of order 2
2. Introduction to hyperbolic, elliptic, parabolic equations
3. Partial differential equations of order 1
4. Introduction to the theory of distributions

Objectives (and/or specific learning outcomes)

Numerical methods :

- Formulate a numerical method for the resolution of partial differential equations
- Write a program in the Python language to solve a large range of problems described py partial differential equations
- Usage of programming tools including: jupyter notebook, numpy / scipy / matplotlib packages, git / github.

Group theory :

- Master the notions of group and algebra
- Become familiar with the representations of the group of rotations and of space-time transformations, in view of their many uses in physics

Partial differential equations :

- Recognize the different types of partial differential equations of order 2
- Solving some specific equations (separation of variables, Green functions, equations of order 1)

Pre-requisits and co-requisits

Pre-requisites courses

INFO-F207 | Informatique | 5 crédits and MATH-F201 | Calcul différentiel et intégral II | 10 crédits

Teaching method and learning activities

Numerical methods :

Classes with integrated practical exercises / flipped classes / personal work.

Group theory :

classes and exercises, personal work

Partial differential equations :

classes and exercises, personal work

References, bibliography and recommended reading

- Syllabus
- Université virtuelle

Other information

Place(s) of teaching

Plaine

Contact(s)

Analyse numérique : Prof. B. Knaepen, bernard.knaepen@ulb.be
Théorie des groupes : rargurio@ulb.ac.be
Équations aux dérivées partielles : julie.distexhe@ulb.be
https://uv.ulb.ac.be/course/view.php?id=92718

Evaluation method(s)

Other

Evaluation method(s) (additional information)

Numerical methods :

- Written exam on the course material
- One homework to be handed in before the winter holidays. This homework cannot be presented again in second session. The mark obtained in first session is automatically transferred to the second session.

Group theory :

- Written exam on the course material and the exercises
- Oral exam on the course material

Partial differential equations :

- Personal works during the period of teaching
- Oral exam on the course material and the exercises

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

Numerical methods :

Written exam: 75%

Homework (project): 25%

Group theory :

Written exam: 50%

- Oral exam : 50%

Partial differential equations :

- Oral exam : 50%
- Personal works : 50%

If the marks obtained for all the parts of the course are >= 10, the final mark will be the weighted average of the marks obtained in each of the three parts. Otherwise, the final mark will be the lowest mark among the three marks obtained.

Main language(s) of evaluation

French

Other language(s) of evaluation, if applicable

English

Programmes

Programmes proposing this course at the faculty of Sciences

BA-PHYS | Bachelor in Physics | unit 3