MATH-305

Introduction to partial differential equations

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Cursus	Sem.	Type
Mathematics	BA5	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Oral
Workload	150h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This is an introductory course on Elliptic Partial Differential Equations. The course will cover the theory of both classical and generalized (weak) solutions of elliptic PDEs.

Content

- Classification of PDEs, basic properties of first order, elliptic, parabolic, and hyperbolicPDE
- Laplace equation; mean value property; maximum principle; fundamental solution; Dirichlet problem; Poisson integral and Newtonian potential; regularity theory in Holder spaces;
- General second order linear elliptic equations; maximum principle; a priori bounds;
- Sobolev spaces; weak derivatives and their properties; density results; extension results; traces; imbedding theorems; Poincaré inequalities;
- Weak solutions of general elliptic equations; Lax Milgram theorem; existence and uniqueness results; regularity theory in Sobolev spaces; compactness results and non coercive problems;

Learning Prerequisites

Required courses

Analysis I-IV

Recommended courses

Measure and Integration; Functional Analysis I

Learning Outcomes

By the end of the course, the student must be able to:

- Classify different types of PDEs
- Define different notions of solutions
- Analyze the properties of solutions of PDEs
- Prove existence and regularity results of solutions of elliptic PDEs

Transversal skills

- Use a work methodology appropriate to the task.

- Demonstrate a capacity for creativity.
- Demonstrate the capacity for critical thinking

Teaching methods

Ex cathedra lectures, exercises in classroom

Assessment methods

Oral exam

Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

The course will be based on notes that will be provided to the students. The following books can be also be used as secondary references:

- David Gilbarg, Niel S. Trudinger, Elliptic Partial Differential Equations of Second Order, Springer-Verlag, 2nd edition, 2001.
- Lawrence C. Evans. Partial Differential Equations, AMS-Graduate Studies in Mathematics, 2nd edition, 2010.
- Haïm Brézis, Functional Analysis, Sobolev Spaces and Partial Differential Equations, Springer, 2011
- Fritz John, Partial Differential Equations, Springer-Verlag, 4th edition, 1982

Ressources en bibliothèque

- Find the references at the Library

Notes/Handbook

Lecture notes available on the webpage

Moodle Link

- https://go.epfl.ch/MATH-305

Prerequisite for

- Master courses on theory of PDEs: Equations aux dérivées partielles d'évolution, Calculus of variations, Optimal Transport, Dispersive PDEs, Theory of stochastic calculus, Nonlinear Schrödinger equations, Distributions and interpolation spaces; Introduction to general relativity; Introduction to stochastic PDEs
- Bachelor / Master courses on numerical approximation of PDEs: Numerical Approximation of PDEs; Numerical methods for conservation laws; Computational finance; Numerical integration of stochastic differential equations; Numerics for fluids, structures & electromagnetics;