PHYS-332 **Computational physics III**

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Cursus	Sem.	Type
Computational science and Engineering	MA2, MA4	Opt.
Physics	BA6	Opt.

Language of teaching	English
Credits	3
Withdrawal	Unauthorized
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	1 weekly
TP	2 weekly
Number of positions	

It is not allowed to withdraw from this subject after the registration deadline.

Summary

This course teaches the students practical skills needed for solving modern physics problems by means of computation. A number of examples illustrate the utility of numerical computations in various domains of physics.

Content

Fourier series and transforms Introduction to the Fourier series and transforms and their application. Mathematical properties: convergence, convolution, correlation, Gibbs phenomenon and the Wiener-Khinchin theorem. Fourier transform on discrete sampled data: aliasing and sampling theorem. Discrete Fourier transform (DFT) and fast Fourier transform (FFT). Applications: spectral analysis, filters. Fourier transforms in higher dimensionality.

Linear systems Introduction and examples. Gauss-Jordan elimination, LU factorization. Iterative refinement: tridiagonal and band diagonal systems. Iterative methods and preconditioning: Jacobi, Richards and gradient methods. Conjugate gradient method. Iterative vs direct methods.

Matrix manipulation and eigenvalues problems Introduction and examples. Properties and decomposition. Poweriteration. QR decomposition and iterative procedure. Singular value decomposition (SVD).

Learning Prerequisites

Recommended courses

1st and 2nd years numerical physics courses

Learning Outcomes

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

- Choose the most suitable algorithm for solving given problem
- Integrate algorithms in computer codes and evaluate their performance
- Solve actual physics problems using numerical tools

Teaching methods

Ex cathedra presentations, exercises and work under supervision

Assessment methods

3 reports during the semester

Resources

Bibliography

J. F. James, A Student's guide to Fourier transforms, CUP 2011
L. N. Trefethen and D. Bau III, Numerical linear algebra, SIAM 1997

Ressources en bibliothèque

- Numerical linear algebra / Trefethen
- A Student's guide to Fourier transforms / James