## Mathematical Methods in Physics (C001887)

**Course size** (nominal values; actual values may depend on programme)

Credits 6.0  Study time 180 h  Contact hrs 60.0 h

**Course offerings and teaching methods in academic year 2018-2019**

| A (semester 1) | Dutch | seminar: coached exercises | 30.0 h |
| | | seminar: practical PC room classes | 2.5 h |
| | | lecture | 25.0 h |
| | | group work | 2.5 h |

**Lecturers in academic year 2018-2019**

| Dierckx, Hans | WE05 | lecturer-in-charge |
| Verschelde, Henri | WE05 | co-lecturer |

| Offered in the following programmes in 2018-2019 | crdts | offering |
|---|---|---|
| Bachelor of Science in Physics and Astronomy | 6 | A |

**Teaching languages**

Dutch

**Keywords**

Mathematical physics, special functions, partial differential equations

**Position of the course**

The aim of this course is to learn to use in a practical manner the mathematical techniques and methods useful in physics, not covered by previous courses. At the end of the course, the student should be able to translate a physical problem in mathematical form (PDE, boundary value problem) and solve the problem analytically in an efficient way.

**Contents**

Vector analysis. Curvilinear coordinates. Complex analysis. Ordinary second order differential equations in the complex plane. Method of Frobenius.sturm-Liouville problem. Bessel functions. Legendre functions. Application to practical problems. Laplace transform.

**Initial competences**

Basic knowledge of mathematical analysis and linear algebra is sufficient.

**Final competences**

1 The student is acquainted with elementary mathematical techniques in physics, such as vector calculus, complex analysis, integral transforms, Hilbert spaces and generalized Fourier series. He/She understands the physical implications of several mathematical properties.
2 The student is able to grasp the essence of a physical problem and to convert it to a mathematical problem, e.g. initial or boundary-value problem, including appropriate boundary conditions.
3 The student can recognize when common mathematical methods in physics are suitable to apply, and apply them independently.
4 The students are aware of the approximations and limitations which come with physical models of reality (e.g. assumption of linearity), leading them to critically interpret their results.
5 The student has gained experience with teamwork on a joint scientific project and its reporting.

6   The student has gained experience in the computer-aided visualization of a physical system.

7   The student is able to report his/her findings as a small research article structured as introduction - methods - results - discussion.

## Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

## Conditions for exam contract

This course unit cannot be taken via an exam contract

## Teaching methods

Group work, lecture, seminar: coached exercises, seminar: practical PC room classes

## Extra information on the teaching methods

New mathematical methods are introduced during theory lessons (45% of total time). These techniques are than applied and thoroughly assimilated during guided excercise sessions, with emphasis on concrete physical problems.

## Learning materials and price

Handbook
G. Arfken : Mathematical Methods in Physics, Academic Press, San Diego (1985). (Estimated cost: 100 Euro)

## References

G. Arfken : Mathematical Methods in Physics, Academic Press, San Diego (1985).
P. Morse , H. Feshbach: Methods of Theoretical Physics, McGraw-Hill, (1953)

## Course content-related study coaching

The lectures and excercise classes are meant to be interactive sessions. In case of more questions, the teacher and assisting personnel can be contacted anytime during the semester. Additional notes and explanation with the excercises and project are uploaded on Minerva.

## Evaluation methods

end-of-term evaluation and continuous assessment

## Examination methods in case of periodic evaluation during the first examination period

Written examination with open questions

## Examination methods in case of periodic evaluation during the second examination period

Written examination with open questions

## Examination methods in case of permanent evaluation

Assignment, peer assessment

## Possibilities of retake  in case of permanent evaluation

examination during the second examination period is possible in modified form

## Extra information on the examination methods

The exam consist of three or four concrete problems to be solved which are of the same sort as those solved during the excercise sessions.
During the year, students work in small groups on a project in which mathematical methods are applied to a physics problem. The results are visualised and discussed.

## Calculation of the examination mark

80 % exam excercises
20% project during the year. Based on peer assessment, the scores within each group of students working on the same project can be weighted.
If a student fails and also failed for the project separately, he/she may redo the project in the next examination round.