Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course Specifications
Valid as from the academic year 2020-2021

Mathematics in Photonics (E002640)

Course size
Credits 4.0
Study time 120 h
Contact hrs 30.0 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 1) English Gent
lecture 15.0 h
seminar: coached exercises 15.0 h

Lecturers in academic year 2020-2021
Bienstman, Peter TWOS
lecturer-in-charge

Offered in the following programmes in 2020-2021

<table>
<thead>
<tr>
<th>Credits</th>
<th>offering</th>
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<tr>
<td>Bridging Programme European Master of Science in Photonics</td>
<td>4</td>
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<tr>
<td>European Master of Science in Photonics</td>
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Teaching languages
Dutch, English

Keywords
applied mathematics, photonics

Position of the course
Exposing the student to various mathematical concepts often used in photonics. The aim is to make the student acquainted with the basic principles and references, in order to allow him to independently further research these concepts.

Contents
- 1: Complex analysis: wave problems as problems from complex analysis, complex functions, analytic functions, derivatives, line integrals, poles, zeros, branch cuts, residue calculus, limit theorems, Cauchy principal value, Kramers-Kronig dispersion relation, conformal transformations, bend losses in optical waveguides
- 2: Special functions: modes of an optical fibre, Bessel and Neuman functions, generating functions, recursion relations, integrals, orthogonality, series expansion, higher order solutions of the paraxial wave equation, Hermite polynomials, generating function, recurrence relation, differential equation, orthogonality, series expansion
- 3: Numerical techniques: finite elements, finite differences, variational methods, eigenmode expansion, method of weighted residuals
- 4: Periodicity and symmetry in photonic systems: using symmetries to classify modes, Bloch theorem, band diagrams, photonic crystals
- 5: Dynamical systems: origins of non-linearity in optical systems, stability, fixed points, the logistic map, saddle points, bifurcations, chaos, period doubling, Lyaponov exponent, stable and unstable manifold

Initial competences
mathematics from the bachelor program

Final competences
1 being able to apply complex analysis to photonic problems
2 being able to apply special functions and orthogonal polynomials to photonic problems
3 getting a basic insight in the effects of symmetry on photonic systems
4 getting a basic insight into numerical techniques for photonics
5 being able to study the dynamics of a photonic system

(Approved)
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

Guided self-study, lecture, seminar: coached exercises.

Learning materials and price

full lecture notes

References

Course content-related study coaching

Evaluation methods

end-of-term evaluation

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

Open book examination, oral examination

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

Open book examination, oral examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

During examination period: oral open-book exam

Calculation of the examination mark

6. being able to study a new mathematical topic in an independent and critical manner and apply it in a creative way.