DEPARTMENT OF PHYSICS

FYP201 Mathematical physics A, 7.5 credits

Matematisk fysik A, 7,5 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2011-10-17 and was last revised on 2020-06-01 to be valid from 2020-07-01, autumn semester of 2020.

Field of education: Science 100%
Department: Department of Physics

Position in the educational system

The course is included in the Bachelor of Science in Physics and the Medical Physicist Programme. It is also given as a freestanding course.

The course can be part of the following programmes: 1) Bachelor of Science in Physics (N1FYS), 2) Medical Physicist Programme (N1SJU) and 3) Master's Programme in Chemistry (N2KEM)

Main field of studies	*Specialization*
Physics	G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements

Entry requirements

For admission to the course, completed courses are required from the first two semesters of the Bachelor of Science in Physics programme, or that the equivalent knowledge has been acquired in some other way.

Learning outcomes

After completion of the course Mathematical physics A, the student should be able to:

Knowledge and understanding

- provide examples of different curvilinear koordinatsystems, how they relate to symmetries in problems and why different systems are suitable in different cases
- explain the concepts basevectors, coordinate surfaces and coordinate lines for curvilinear coordinate systems
- provide a few examples from physics relating to vector integrals, *e.g.*, curve integrals, surface integrals and volume integrals
- understand the importance of being able to formulate physical laws on vector form without using a specific coordinate system
- account for Gauss' och Stoke's theorems
- explain the relation between fields and different source distributions and the dimensionalities of the latter
- explain the idea behind the Dirac delta function and how it can be used
- explain the underlying principle behind the Green's function method to determine fields from source distributions

Competence and skills

- express differentialoperators, gradient, divergence and rotation in general curvilinear coordinate systems and apply these to field equations
- determine equations describing field lines and equipotential surfaces in curvilinear coordinate systems
- parametrize curves and surfaces in curvilinear coordinate systems and calculate line-, surface and volume integrals
- apply integral theorems, *e.g.*, Stoke's, Gauss', etc, to determine integrals over regular and singular fields
- use index notation to prove theorems and simplify expressions containing vectors, tensors and differential operators
- show how the Dirac delta function can be expressed via a limiting procedure and apply the function to treat singularities
- express fields in terms of scalar and vector potentials
- calculate fields from source distributions; point-, line-, surface and space charge distributions
- apply the Green's function method and separation of variables to solve Poisson's and Laplace's equations
- solve the diffusion equation using separation of variables and using the heat kernel

Judgement and approach

- show a crude insight into the generality of common mathematical concepts and methods in physics
- appreciate the value of identifying symmetries in physical problems
- appreciate the formulation of mathematical models independent of coordinate systems, *i.e.,* on vectorial- and tensor form.

Course content

Scalar fields and vector fields, differential operator calculus, curvilinear coordinate system, vector integrals such as curve integrals, surface integrals, volume integrals, integral theorems such as Gauss' and Stoke's theorems, divergence and rotation in curvilinear coordinate systems, index notation, singular fields, fields from line sources, surface sources and source distributions, the Dirac delta function, potential theory for Laplace's and Poisson's equations, an introduction to Green's functions, separation of variables, the diffusion equation and the heat kernel.

Form of teaching

Lectures, consultations, tutorials and home problems.

Language of instruction: Swedish

Assessment

Written examination.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation

A course evaluation should be arranged after the course has ended where all participating students are given the possibility to provide anonymous feedback via a course survey. The course responsible should, together with student representatives, discuss and assess the completed survey. Meeting notes should afterwards be made available via the university learning platform.