



Faculty of Health, Science and Technology  
Mathematics

## Syllabus

### Partial Differential Equations and the Finite Element Method

<b>Course Code:</b>	MAAD20
<b>Course Title:</b>	Partial Differential Equations and the Finite Element Method <i>Partiella differentialekvationer och FEM</i>
<b>Credits:</b>	7.5
<b>Degree Level:</b>	Master's level
<b>Progressive Specialisation:</b>	Second cycle, has only first-cycle course/s as entry requirements (A1N)

**Major Field of Study:**  
MAA (Mathematics)

#### Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology 2020-03-16, and is valid from the Autumn semester 2020 at Karlstad University.

#### Prerequisites

90 ECTS credits in Mathematics and upper secondary level English 6 or B, or equivalent

#### Learning Outcomes

Upon completion of the course, students should be able to:

- calculate weak derivatives of given functions,
- derive the weak formulation of a given elliptic partial differential equation with different types of boundary conditions,
- prove the existence and uniqueness of the weak solution to certain linear elliptic partial differential equations,
- prove weak maximum principles for certain elliptic partial differential equations,
- calculate finite element approximations for weak solutions to certain differential equations,

- derive error estimation for finite element approximations, and
- formulate and prove a given selection of relevant theorems covered in the course.

**Content**

Weak derivatives and Sobolev space. Compactness. Embedding and trace theorems. Weak formulations and weak solutions to elliptic partial differential equations. Lax-Milgram's lemma. Existence and uniqueness in weak solutions. Weak maximum principles. Finite element method. Ritz projections. Derivation of a priori and a posteriori error estimations with explicit convergence speed.

Students carry out an individual project.

**Reading List**

See separate document.

**Examination**

Assessment is individual and based on a written report and an oral presentation.

If students have a decision from Karlstad University entitling them to special pedagogical support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

**Grades**

One of the grades Distinction (VG), Pass (G), or Fail (U) is awarded in the examination of the course.

**Quality Assurance**

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

**Course Certificate**

A course certificate will be provided upon request.

**Additional information**

The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.