COURSE SYLLABUS

Mekanikens approximativa beräkningsmetoder 1

Computational Engineering 1

7.5 credits (7,5 högskolepoäng)

Course code: MT2558
Main field of study: Mechanical Engineering
Disciplinary domain: Technology
Education level: Second cycle
Specialization: A1N - Second cycle, has only first cycle course/s as entry requirements

Subject area: Mechanical Engineering
Language of instruction: English
Applies from: 2019-01-21
Approved: 2018-10-01

1. **Decision**
   This course is established by Dean 2018-01-24. The course syllabus is approved by Head of Department of Mechanical Engineering 2018-10-01 and applies from 2019-01-21.

2. **Entry requirements**
   Admission to the course requires taken course Structural Analysis 7.5 credits.

3. **Objective and content**

   3.1 Objective

   3.2 Content
   The students gain knowledge and skills of semi-analytical and numerical calculation methods for extensive engineering analysis in e.g. the product development process. Engineering Tribology, Heat Conduction and Solid Mechanics are the primary fields of application used for introduction of the calculation methods in the course. The students will develop skills in creating theoretical models, deriving relevant equations and solving equations by appropriate methods. This will give deepened understanding of how existing calculation software works and of their possibilities and limitations. The ability to develop complementary software for special purposes will also be increased. Searching for scientific information and communicating scientific facts and relationships will be thoroughly practiced.
   This course focuses on one-dimensional problems and gives an introduction and the fundamental theory and skills needed for the continuation course Computational Engineering 2. The topics covered are described by the keywords below:

   • Numerical Solution of Ordinary Differential Equations,
   • Initial Value Problems,
   • The Euler Method,
   • The Modified Euler Method,
   • The Trapezoidal Method,
   • The Midpoint Method,
   • Richardson Extrapolation,
   • Runge-Kutta Methods,
   • Multi-step Methods,
   • Systems of Ordinary Differential Equations,
   • Boundary Value Problems,
   • The Shooting Method,
   • The Finite Difference Method,
   • Weighted Residual Methods,
   • The Finite Element Method,
   • One-dimensional Element Types,
   • Shape Functions and Weight Functions,
   • Transient Problems,
   • Time Marching Schemes,
   • Explicit Integration,

- Implicit Integration,
- Nonlinear Problems,
- Algorithms and Programming,
- Errors and Convergency,
- Commercial Computation Software,
- Fluid Lubrication Theory,
- Lubricant Characteristics,
- Environmental Aspects of Lubricants,
- Heat Transfer Theory,
- Solid Mechanics Theory,
- Nondimensional Quantities.

4. Learning outcomes

The following learning outcomes are examined in the course:

4.1 Knowledge and understanding

On completion of the course, the student will be able to:

- be able to show knowledge and understanding of how semi- analytical and numerical methods can be used and be implemented in software for computational engineering analysis, providing decision support in product development.

4.2 Competence and skills

On completion of the course, the student will be able to:

- be able to derive governing equations for a given onedimensional initial- or boundary value problem
- be able to solve given types of equations with prescribed analytical and/or numerical method using own software implementation.

4.3 Judgement and approach

On completion of the course, the student will be able to:

- be able to interpret, validate and communicate analysis results.

5. Learning activities

The teaching comprises lectures, laboratory work, project work, seminars and exercises. Theories and methods are presented and discussed in the form of lectures / seminars. A number of exercise problems and a project supporting the learning and understanding of the theory. Students develop their own computer programs for solution of the given problems. Advantages and disadvantages of the methods are discussed based on this experience.
Applications are related to industry relevant problems.

6. Assessment and grading

Modes of examinations of the course

Code	Module	Credits	Grade
1905	Written assignment	4 credits	AF
1915	Written examination	3.5 credits	AF

The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Fail, supplementation required, F Fail.

The course will be graded A Excellent, B Very good, C Good, D Satisfactory, E Sufficient, FX Insufficient, supplementation required, F Fail. At grade FX on a module, the student will be given an opportunity to complement the work within 6 weeks for a grade E. The final grade is a weighted sum of all modules. Each module consists of several smaller oral and written tasks according to information given at the course start. All tasks of a module need to be approved to get approved on a module.

The course information for each course revision should include the assessment criteria and make explicit in which modes of examination that the learning outcomes are assessed.

7. Course evaluation

The course evaluation should be carried out in line with BTH:s course evaluation template and process.

8. Restrictions regarding degree

The course can form part of a degree but not together with another course the content of which completely or partly corresponds with the contents of this course.

9. Course literature and other materials of instruction

- Broman G.: Computational Engineering, Department of Mechanical Engineering, Blekinge Institute of Technology, 2003.

• Ottosen N. S. and Petersson H.: Introduction to the Finite Element Method, Prentice Hall, 1992.
• Lindfield G. and Penny J.: Numerical Methods Using Matlab, Ellis Horwood, 2000.
or later edition.

10. Additional information
This course replaces the course MT2526