FMJ3411 Numerical Heat Transfer in Energy Technology 7.5 credits

Numerisk värmeöverföring i energiteknik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

On 2021-11-11, the Dean of the ITM School has decided to establish this official course syllabus to apply from spring semester 2022, registration number: M-2021-1812.

Grading scale

P, F

Education cycle

Third cycle

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completing the course with a passing grade the student should be able to:

1. Derive numerical methods for treating partial differential equations in heat tranfer, develop specific expressions for programming, and analyze sources of error
2. Define governing equations for relevant heat transfer processes and construct representative numerical simulations
3. Account for current developments in numerical heat transfer methods and software, compare different methods, and contrast selected approaches through analysis
4. Conduct numerical simulations with commercial computational software and analyze results in terms of validity and accuracy, including comparisons to real heat transfer processes

Course contents

The purpose of this course is to provide a solid background on numerical methods relevant to heat transfer and fluid flow in energy applications, with emphasis on component design. Participants successfully completing this course will have adequate preparation for subsequent studies where commercial computational fluid dynamics (CFD) codes are to be employed. The following topics are covered in the course:

- Numerical solutions to differential equations
- Error analysis in numerical methods
- Governing equations for heat transfer in solid materials and radiative exchange
- Governing equations for fluid flow: conservation of mass, linear momentum, and energy
- Finite difference method for 1D and 2D conduction heat transfer
- Euler's solution method and higher-order time discretization in transient conduction heat transfer
- Stability criteria for explicit time marching solutions
- Advection equation and relevance to convective heat transfer
- Implicit time marching schemes for advection
- Introduction to Navier-Stokes equations and turbulence, and their numerical treatment

Specific prerequisites

Admitted to PhD studies

Examination

- INLA - Home assignment, 0.5 credits, grading scale: P, F
- INLB - Home assignment, 0.5 credits, grading scale: P, F
- LABA - Computer laboratory, 3.0 credits, grading scale: P, F
- LIT1 - Literature review, 1.5 credits, grading scale: P, F
- TEN1 - Exam, 2.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.