Transient Finite Element and Finite Difference Methods

Module-No./Abbreviation	Credits	Workload	Term	Frequency	Duration
CE-WP30/ TFEM	6 CP	180 h	2nd Sem.	Summer Semester	1 Semester

Courses	Contact hours	Self-Study	Group Size:
Transient Finite Element and Finite Difference Methods	4 SWS (60 h)	120 h	No Restrictions

Prerequisites

Finite Element Methods in Linear Structural Mechanics (CE-P05)

Learning goals / Competences

After successfully completing the module the students

- understand the mathematical formulations of transient problems, including ordinary differential equations (ODEs) and partial differential equations (PDEs)
- understand principles of numerical time integration schemes, their stability and accuracy
- learn to assess the validity of the simulations, and interpret physical implications
- gain hands-on experience in implementing numerical methods for transient problems

Content

a) Introduction to transient problems and analysis
   - Hamilton's principle and Euler-Lagrange differential equation
   - Classification of transient problems and applications in engineering
   - Overview of numerical approaches

b) Time integration of ODEs
   - Explicit and Implicit methods
   - Time integration of first order ODEs
   - Stability and accuracy analysis
   - Time integration of second order ODEs
   - Error estimates and Adaptive time stepping

c) Time integration of PDEs
   - Finite differences in space and time
   - Diffusion and wave equation

d) Outlook on Advanced topics in transient analysis
   - Fluid flow problems
   - Multiphysics problems

Teaching methods / Language

Lecture (2h / week), Exercises (2h / week) / English

Mode of assessment

Classroom quizzes, Homework assignments

Requirement for the award of credit points

Passed all quizzes and assignments

Module applicability

MSc. Computational Engineering, MSc. Bauingenieurwesen

Weight of the mark for the final score

Module coordinator and lecturer(s)

Prof. Dr. Roger A. Sauer, Dr.-Ing. Sahir N. Butt

Further information

Can NOT be combined with CE-WP11 or BI-WP06