Module Nr.	Credits	Workload	Semester	Frequency	Duration
SE-C-2	9 CP	270 h	1	Yearly (WS)	1 Semester
Courses			**Contact time**	**Self-study**	**Group Size**
a) FEM in Linear Structural Mechanics			4 h/week	120 h	---
b) Soil Behaviour and Simple Constitutive Models for Soils			2 h/week	60 h	

Computational Methods 1

Learning outcomes

After successfully completing the module, the students

- have basic knowledge of the Finite Element Method (FEM),
- are able to transfer initial boundary value problems of structural mechanics into discretised calculation models based on FEM and thus to solve simple tasks of structural mechanics independently (e.g. calculation of truss structures, disc-like or volume structures),
- have advanced knowledge to understand the functionality of calculation programs based on FEM and to critically evaluate their results,
- are able to independently implement corresponding user-defined elements in FE programs and perform numerical analyses of beam and shell structures
- have knowledge to solve simple coupled problems (temperature, structural mechanics).
- can assess the constitutive behaviour of the soil under different hydromechanical loading conditions,
- are able to develop strategies to apply simple constitutive laws to model the fundamental soil behaviour in numerical simulations and understand the limitations of these models
- are able to determine the parameters of simple constitutive models from laboratory test results

Content

a) FEM in Linear Structural Mechanics

The course covers the basic knowledge of linear FEM, which is based on the principle of virtual work. In particular, the following topics are taught in the course:

- Isoparametric finite elements for trusses, slices, beams, shells, three-dimensional volume elements for application in statics and dynamics,
- Finite element formulations for coupled (e.g. thermo-mechanical) problems,
- consistent explanation of the fundamentals (basic equations, principle of variation),
- Numerical integration, assembly of the elements to a discretized structure and the solution of the static and dynamic structure equation,
- Discussion of stiffening effects ("locking") and their avoidance.

b) Soil Behaviour and Simple Constitutive Models for Soils

The course introduces the conventional and advanced laboratory testing methods and addresses expected soil behaviour under monotonic and cyclic loading conditions from numerical modeling perspectives. Fundamentals of standard elastoplasticity applied to geotechnical materials in accordance to failure criteria will be introduced. Additionally, it discusses the fundamentals, advantages and limitations of widely used simple constitutive models for soils such as:

- Linear Elastic (LE) model

• Mohr-Coulomb (MC) model • Hardening Soil (HS) model Finally, the calibration of simple constitutive models from laboratory tests will be discussed and these models will be applied to different geotechnical problems.
Teaching methods / Language a) Lecture (2h / week), Exercises (2h / week)/ English b) Lectures (2h / week) / English
Modes of assessment Written examination (180 min.)
Requirements for the award of credit points Passing the written examination
Module applicability (in other study programs) Master Computational Engineering, Master Bauingenieurwesen,
Weight of the mark for the final score 7.5 %
Module coordinator and lecturer(s) a) Prof. Dr. techn. G. Meschke (coordinator) b) Prof. Dr.-Ing. habil. T. Wichtmann; Dr.-Ing. A. Lavasan
Other information