Training of Competences (Part 2)

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Module number	Credits	Workload	Semester[s]	Duration	Group size
CE-W02/SE-O-15/ToC II	4 CP	120 h	2./4. Sem.	1 Semester[s]	no limitation

Courses	Contact hours	Self-study	Frequency
a) Training of Competences II	a) 4 WLH (60 h)	a) 60 h	a) each summer

Module coordinator and lecturer(s)

N.N.

a)

Admission requirements

Participation on CE-W01/SE-O14/ToC I is obligatory

Learning outcome, core skills

After successfully completing the module, the students

- are able to employ at an intermediate level all four skills (speaking, listening, reading and writing) in familiar universal contexts or shared knowledge situations such as greeting, small talk, shopping, making appointments, eating out, orientation, biography, healthcare etc.

Contents

a)

The learning goals of this German language course fulfill the special requirements of foreign students majoring in a subject that uses English as a teaching language. The main focus of the course lies on intermediate level action-oriented speaking, listening, reading and writing comprehension so that the students learn to cope with everyday situations of their life in Germany. This course continues the learning goals of the module Training of Competences 1.

Educational form / Language

a) Lecture (4 WLH) / English / German

Examination methods

• Written exam 'Training of Competences (Part 2)' (120 min., Part of modul grade 100 %)

Requirements for the award of credit points

- Passed final module examination

Module applicability

- M.Sc. Computational Engineering
- M.Sc. Subsurface engineering
- Special offer for foreign students of the course

Weight of the mark for the final score

Percentage of total grade [%] = 4 * 100 * FAK / DIV

FAK: The weighting factors can be taken from the table of contents.

DIV: The values can be taken from the table of contents.

Further Information

University Language Center (ZFA) of Ruhr-University Bochum

Uncertainty Quantification in FE Analyses with Surrogate Modeling

Uncertainty Quantification in FE Analyses with Surrogate Modeling

Module number	Credits	Workload	Semester[s]	Duration	Group size
BI-WP58/CE-WP29/SE-O-17	6 CP	180 h	3. Sem.	1 Semester[s]	no limitation

Courses	Contact hours	Self-study	Frequency
a) Uncertainty Quantification	a) 2 WLH (30 h)	a) 60 h	a) each winter
b) Surrogate Modeling	b) 2 WLH (30 h)	b) 60 h	b) each winter

Module coordinator and lecturer(s)

Prof. Dr. Roger A. Sauer

a) Dr.-Ing. Gerrit E. Neu

b) Dr.-Ing. Ba Trung Cao

Admission requirements

Recommended previous knowledge:

Fundamental knowledge in structural analysis, Finite Element Method, probability theory, and basic programming (MATLAB, Python)

Learning outcome, core skills

The course equips students with theoretical foundations and practical skills to model, propagate, and mitigate uncertainties in structural analysis. Students will be able to define an uncertainty quantification problem, evaluate the effect of aleatory, epistemic as well as polymorphic uncertainty onto computational models and to interpret the results. It delves into surrogate modeling methods that approximate high-fidelity simulations, enabling efficient uncertainty assessment in complex systems. Applications to structural reliability, optimization, and risk-informed decision-making are emphasized, with hands-on experience using state-of-the-art computational tools.

After successfully completing the modules, the students are able to

- Understand the role and significance of uncertainty in structural engineering and computational models.
- Apply probabilistic and non-probabilistic methods for modeling uncertain parameters.
- Develop and implement surrogate models for efficient uncertainty propagation and sensitivity analysis.
- Use state-of-the-art tools and frameworks to solve real-world problems involving uncertain data.

Contents

a)

The course deals with the uncertain data involving in structural analysis:

- Fundamentals of uncertainty quantification: types and sources of uncertainty (aleatory vs. epistemic)
- Sources of uncertainty in structural engineering: material properties, geometry, boundary conditions, and external loads
- Computing with uncertainty models: stochastic model, interval analysis, fuzzy logic, and polymorphic model
- Evaluation of model responses due to uncertain inputs: Quantification by statistical measures, sensitivity analysis and structural reliability

b)