WINB350R Digital Manufacturing and Numerical Calculation

Module name: *Digital Manufacturing and Numerical Calculation*
Module overview
EDP designation: WINB350R
Module coordinator(s): Prof. Dr Florian Finsterwalder (Prof. Dr Griesbaum)
Module scope (ECTS): 5 CP (45 hours of attendance and 105 hours of self-study including exam preparation)
Classification (semester): 3rd or 4th curriculum semester
Content requirements: Knowledge of mathematics and technical mechanics, comparable to the modules Mathematics for Engineers I and II, Technical Mechanics
Prerequisites according to SPO: None
Competences: Using a classification scheme, students will be able to name the most important processes and technologies of digital, in particular additive manufacturing, as a prerequisite for a targeted selection of processes. They will also be able to explain the materials used. Furthermore, students will be able to use practical exercises and experiments to master the use of common 3D printers and use them to independently produce components. When designing and constructing their own components or assemblies, students apply the methods they have learnt in product development and -design, and in this way become familiar with the process chain through to post-processing and critically examine it in order to be able to select and apply the optimum production technologies for selected problems. In some cases, students also examine new (manufacturing) technological approaches on the basis of current publications, for example to further improve quality or productivity and thus the cost situation of digital manufacturing, especially in comparison to traditional template-based processes. Students assess new business models that arise in the context of digital or additive manufacturing. Finally, students analyse trends based on current publications and develop new ideas for product development and engineering of the future, particularly with regard to the use of artificial intelligence. Students can numerically implement selected analytical calculation methods in engineering mechanics and visualise the results clearly. They can model and analyse elementary mechanical load cases using commercial FEM software and interpret the results. They can apply the method of topology optimisation to geometrically simple components and evaluate the resulting structures using the analytical methods of engineering mechanics. Students gain an insight into the field of numerical calculation, which is an established component in the development of sophisticated and highly resilient components, for example in mechanical and plant engineering. Calculation methods are increasingly being used in the development of additively manufactured components in order to optimally utilise the potential of additive manufacturing. The course prepares students to make

decisions in the context of additive manufacturing with accompanying computational analyses where necessary.
Examination: Written exam (90 minutes) or written exam (45 minutes) and coursework (completion of smaller tasks over the course of the semester). The specific form of examination will be announced at the beginning of the course.
Usability:

Course: Digital Manufacturing
EDP designation: WINB351R
Lecturer: Prof. Dr Florian Finsterwalder
Hours per week (SWS): 2 SWS
Availability: annually in the summer semester
Type and mode: Lecture with laboratory / compulsory subject in the specialization Intelligent Production Systems
Teaching language: German or English
Contents: • Introduction to additive manufacturing, classification and differentiation from conventional manufacturing technologies • Process overview • Materials and substances • Device design and components • Modelling • Production-oriented design and optimisation • Work on own problem (regarding process, product or application) using the methods learned, e.g. topology optimisation
Recommended literature: Andreas Gebhardt, Additive manufacturing processes, Carl Hanser Verlag Munich, 2016. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, Additive Manufacturing Technologies, Springer-Verlag, 2021.
Notes:

Course: Numerical Calculation
EDP designation: WINB352R
Lecturer: Prof. Dr Rainer Griesbaum
Hours per week (SWS): 2 SWS
Availability: annually in the summer semester
Type and mode: Lecture with exercise / compulsory subject in the specialization Intelligent Production Systems
Teaching language: German
Contents:

- Beam as finite element, trusses, calculation of beam forces and nodal displacements using the finite element method (FEM). Calculate and visualise stresses and deformations of the beam using FEM.
- Check production-oriented design for additive manufacturing with FEM, for example notch shape optimisation with tension triangles.
- Topology optimisation with MATLAB: a beam becomes a truss.
- Topology optimisation with Autodesk Fusion 360 and/or ANSYS Workbench: a practical example.

Recommended literature:

- Knothe, Klaus; Wessels, Heribert: Finite Elements - An Introduction for Engineers. Berlin, Heidelberg: Springer-Verlag, 2017.
- Mattheck, Claus: The body language of components - encyclopaedia of form-finding according to nature. Karlsruhe: KIT publishing house, 2017.
- Steinke, Peter: Finite Element Method - Computer-aided introduction. Berlin, Heidelberg: Springer-Verlag, 2015.

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