Studiengang: *Program:*	**Master of Science Maschinenbau** *Master of Science in Mechanical Engineering*			FACH HOCHSCHULE LÜBECK University of Applied Sciences
1 Modul: *Module:*	**Mechanics of Solids** *Festkörpermechanik*			**English** *Englisch*
	Semester *Semester*	**Dauer** *Duration*	**Status** *Status*	**Turnus** *Regular cycle*
	1. Semester	1 Semester	elective	annual
	Kreditpunkte *Credits*	**Aufwand** *Workload*	**Kontaktzeit** *Contact-hours*	**Selbststudium** *Student's efforts*
	5 ECTS	150hrs	4hrs/week = 60hrs Lecture	15hrs Preparation and post processing 75hrs Self-study

2 Beschreibung
Description

The Continuum mechanics is subdivided into the mechanics of solids and the mechanics of fluids. Many basics are common to both disciplines; the mean focus of the present module is placed on the mechanics of solids. In contrast to engineering mechanics, which is basically 1-dimensional, continuum mechanics consider all three dimensions in general.
Continuum mechanics of solids is a basic requirement for the comprehension of all mechanical processes beyond the common engineering mechanics, e.g. the theory of plates and shells, large deformations, theory of elastic-plasticity etc. on the one hand, fracture mechanics, micro mechanics, material phase transformations etc. and the interface to material science on the other hand.

3 Lernziele
Learning Outcomes

- Knowledge of the fundamentals of modern continuum and solid mechanics including the calculus on Riemannian manifolds and the foundations of nonlinear theory, as they are required for the reading of modern textbooks on solid and continuum mechanics and related topics.
- The student acquires the qualification for further education in mechanics as required for master and PhD studies in mechanics and modern theoretical material sciences at universities.
  Remark: Several master courses on mechanical and civil engineering at well established universities e.g. like Darmstadt, Hannover, Braunschweig, Aachen, Bochum et c. include an education in solid and continuum mechanics.

4 Schlüsselqualifikationen
Key qualifications

Sozialkompetenz *Social Competence*	Methodenkompetenz *Competence in Methods*	Selbstkompetenz / Personenkompetenz *Self-Competence Personal Competence*	Interkulturelle Kompetenz *Intercultural Competence*	Medienkompetenz *Media-Competence*
	X			

5 Lehrveranstaltung/ -methoden
Course type and methods

Lecture

- Seminar-like teaching
- Exercises and examples (case studies)

Self-study / homework

- Exercises for the consolidation of the learning matter

6 Vorbedingungen / Vorkenntnisse
Prerequisites

- Strongly recommended: Vector and matrix calculus, differential calculus for functions with variable sets, i.e. differential calculus on vector fields, divergence gradient and curl operator.
- Helpful: Gaussian divergence theorem, Stoke's integral theorem.

7 Arbeitsmittel / Literatur
Required material / Literature

- Worksheets with exercises will be handed out in the lectures and will be placed on the download server.

Literature:

- A. Bertram: Elasticity and plasticity of large deformations. Springer, Berlin, Heidelberg, New York, 2005
- G.E. Mase, G.T. Mase: Continuum mechanics for engineers. London: CRC Press, 1991
- M.E. Gurtin: An introduction to continuum mechanics. Mathematics in science and engineering vol. 158, Academic Press, Inc. 1981
- J. Altenbach, H. Altenbach: Einführung in die Kontinuumsmechanik. Stuttgart: Teubner, 1984

Related Literature:

- C. Miehe: A constitutive frame of elastoplasticity at large strains based on the notion of the plastic metric. Int. J. Solids Structures vol. 35.30 (1998), pp. 3859-3897.
- B. Schieck, H. Stumpf: The appropriate corotational rate, exact formula for the plastic spin and constitutive model for finite elastoplasticity. Int. J. Solids Structures vol. 32.24 (1995), pp. 3643-3667.
- B. Schieck, W. Smolenski, H. Stumpf: A shell finite element for large strain elastoplasticity with anisotropies. Part I: Shell theory and variational principle. Int. J. Solids Structures vol. 36 (1999), pp. 5399-5424. Part II: Constitutive equations and numerical applications. Int. J. Solids Structures vol. 36 (1999), pp. 5425-5451.

Detailinformationen

8 Inhalte

Course topics

Fundamentals of tensor calculus
- Tensor calculus in the Euclidean space
- Tensor calculus in non-Euclidean spaces
- Invariants and tensor functions

Differential calculus of tensors
- Differential operators grad, div, curl
- Integral theorems

Kinematics, the geometry of deformation
- The deformation gradient and its decompositions
- The Lagrangean and the Eulerian setting
- Strain tensors
- Linearized theory
- Compatibility condition

Kinetics, the stress state
- Stress tensors
- Equilibrium conditions

Isotropic elastic material
- Hooke's law for deformations with small strains
- Hyper-elastic isotropic material

Some applications
- Plate theory
- Membrane shell theory

The principle of the minimum of total potential and the principle of virtual work
- Derivations
- Application in the Finite Element Method

Objectivity, invariance requirements
- Frame indifference
- Spatial covariance
- Objective rates

9 Prüfungsform

Assessment

Written examination at the end of the term: 2 hours.

10 Voraussetzung für die Vergabe von Kreditpunkten

Requirements for granting of credits

- Successful passing of exam

11 Weiterführende Veranstaltungen

Related courses

- Selected Topics of Finite Elements

12 Zuordnung

Classification

Mathematik & Naturwissenschaft *Mathematics & Natural Sciences*	Ingenieur-wissenschaften *Engineering Science*	Ingenieur-anwendungen *Engineering Application*	Entwicklung & Konstruktion *Design*	Werkstoffe *Material*	Wirtschaft, Management, Sprachen *General Education*	Anderes *Other*
X	X		X	X		

13 Modulbeauftragter / Lehrpersonen

Responsible person / Lecturers

Prof. Dr.-Ing. B. Schieck