

Module Handbook (<https://modhb.uni-kl.de/>)

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Notes on the module handbook of the department Mechanical and Process Engineering

Die hier dargestellten veröffentlichten Studiengang-, Modul- und Kursdaten des Fachbereichs Maschinenbau und Verfahrenstechnik ersetzen die Modulbeschreibungen im KIS und wurden mit Ausnahme folgender Studiengänge am 28.10.2020 verabschiedet.

Ausnahmen:

- BSc. Bio- und Chemieingenieurwissenschaften (Stand WS 20/21): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MH_BSc_BCI.pdf (https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MH_BSc_BCI.pdf)
- BEd. Lehramt Metalltechnik (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Bachelor_Lehramt_Metalltechnik.pdf (https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Bachelor_Lehramt_Metalltechnik.pdf)
- MSc. Bio- und Chemieingenieurwissenschaften (Stand WS 20/21): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MH_Msc_BCI.pdf (https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MH_Msc_BCI.pdf)
- MEd. Lehramt Metalltechnik Werkstoffe und Fertigung (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Werkstoffe_und_Fertigung.pdf (https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Werkstoffe_und_Fertigung.pdf)
- MEd. Lehramt Metalltechnik Maschinen- und Fahrzeugtechnik (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Fahrzeugtechnik.pdf (https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Fahrzeugtechnik.pdf)
- MEd. Lehramt Metalltechnik Verfahrenstechnik (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Verfahrenstechnik.pdf (https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Verfahrenstechnik.pdf)

Module MV-TM-143-M-4

Non-linear Finite Elements (M, 6.0 LP)

Module Identification

Module Number	Module Name	CP (Effort)
MV-TM-143-M-4	<i>Non-linear Finite Elements</i>	6.0 CP (180 h)

Basedata

CP, Effort	6.0 CP = 180 h
Position of the semester	1 Sem. in WiSe
Level	[4] Bachelor (Specialization)
Language	[DE/EN] German or English as required
Module Manager	Müller, Ralf, Prof. Dr.-Ing. (PROF DEPT: MV) (/staff/83/) Sator, Christian, Dr.-Ing. (WMA DEPT: MV) (/staff/84/)
Lecturers	Müller, Ralf, Prof. Dr.-Ing. (PROF DEPT: MV) (/staff/83/) Schlüter, Alexander, Dr.-Ing. (WMA DEPT: MV) (/staff/271/)
Area of study	[MV-LTM] Applied Mechanics
Reference course of study	[MV-88.808-SG] M.Sc. Computational Engineering (/mhb/FB-MV/cos-559/)
Lifecycle-State	[NORM] Active

Courses

Type/SWS	Course Number	Choice in Module-Part	SL	PL	CP	Sem.
2V+2U	MV-TM-86013-K-4	P	-	PL1	6.0	WiSe

- About **[MV-TM-86013-K-4]**: Title: "Non-linear Finite Elements"; Presence-Time: 56 h; Self-Study: 124 h

Examination achievement PL1

- Form of examination: **oral examination (45-60 Min.)**
- Examination Frequency: each semester
- Examination number: 10013 ("Nonlinear Finite Element Methods")

Evaluation of grades

The grade of the module examination is also the module grade.

Contents

From **[MV-TM-86013-K-4] Non-linear Finite Elements** (/mhb/courses/MV-TM-86013-K-4/):

- Non-linear phenomena in mechanics
- Continuum description of elastic materials at finite deformations
- The weak form of equilibrium in the reference configuration as well as in the current configuration
- Linearization
- Isoparametric concept
- Discretization in the reference configuration as well as in the current configuration
- Implementation of Von-Mises plasticity at small strains
- Time integration of internal variables
- Iterative solution strategies for time-independent, non-linear problems

Competencies / intended learning achievements

From **[MV-TM-86013-K-4] Non-linear Finite Elements** (/mhb/courses/MV-TM-86013-K-4/):

1. Lecture

- Students are able to classify non-linear phenomena
- Students are able to solve non-linear problems by means of the Finite Element Method
- Students understand how to perform time integration for internal variables
- Students know how to choose suitable numerical strategies for non-linear systems of equations
- Students know how to interpret the results of non-linear Finite Element computations

2. Exercise

- Students are able to derive the weak forms of non-linear differential equations
- Students are able to linearize these equations
- Students are able to program finite elements with the software DAEdalon and Matlab
- Students can interpret and analyze the results of non-linear Finite Element simulations
- Students are able to explain and discuss their results and implementations to other participants

Literature

From [MV-TM-86013-K-4] Non-linear Finite Elements (/mhb/courses/MV-TM-86013-K-4/):

- Bathe: Finite Element Methoden, Springer
- Belytschko, Liu, Moran: Nonlinear Finite Elements for Continua and Structures, Wiley 2000
- Crisfield: The Finite Element Method - Non-linear Finite Element Analysis of Solids and Structures, Wiley 1991
- Hughes: The Finite Element Method, Prentice Hall
- Wriggers: Nichtlineare Finite-Element-Methoden, Springer
- Zienkiewicz, Taylor: The Finite Element Method: The Basis, Butterworth-Heinemann
- Zienkiewicz, Taylor: The Finite Element Method: Solid Mechanics, Butterworth-Heinemann

Requirements for attendance (informal)

Applied Mechanics, Continuum Mechanics, Non-linear Continuum Mechanics, Finite Elements

Requirements for attendance (formal)

None

References to Module / Module Number [MV-TM-143-M-4]

Course of Study	Section	Choice/Obligation
[MV-88.808-SG] M.Sc. Computational Engineering (/mhb/FB-MV/cos-559/)	Pflichtmodule	[P] Compulsory
Module-Pool	Name	
[MV-ALL-MPOOL-6 (/mhb/modulepools/MV-ALL-MPOOL-6/)]	Wahlpflichtmodule allgemein	
[MV-MBINFO-MPOOL-6 (/mhb/modulepools/MV-MBINFO-MPOOL-6/)]	Wahlpflichtmodule Maschinenbau mit angewandter Informatik	