

## 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) ([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) ([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) ([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) ([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) ([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) ([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))

## Course MV-LAF-86335-K-7

Mobile Emission Control Fundamentals for Lowest Emission Concepts (2V, 3.0 LP)

### Course Type

SWS	Type	Course Form	CP (Effort)	Presence-Time / Self-Study
2	V	Lecture	3.0 CP	28 h / 62 h
(2V)			3.0 CP	28 h / 62 h

### Basedata

CP, Effort	3.0 CP = 90 h
Position of the semester	1 Sem. in SuSe
Level	[7] Master (Advanced)
Language	[DE] German
Lecturers	Boger, Thorsten, Dr.-Ing. (EXT   DEPT: MV) (/staff/647/) Günthner, Michael, Prof. Dr.-Ing. (PROF   DEPT: MV) (/staff/313/)
Area of study	[MV-LAF] Vehicle Propulsion Systems
Additional informations	<a href="https://laf.mv.uni-kl.de/lehre/">Informations about the course</a> (https://laf.mv.uni-kl.de/lehre/)
Lifecycle-State	[NORM] Active

## Contents

### 1. Introduction

- Emissions of internal combustion engines
- Global air quality challenges
- Emission control regulations
- Measurement of vehicle emissions
- Examples of modern aftertreatment systems

### 2. Heterogeneous Gas-Solid Catalysis Basics

- Function of a catalyst
- Kinetics of catalytically activated reactions
- Heat and mass transfer in gas-solid catalysts
- Catalysis engineering and the role of the catalyst substrate
- Additional considerations for the catalyst and substrate

### 3. Catalytic Exhaust Gas Treatment of Gaseous Pollutants in Stoichiometric Gasoline Engines

- The Three-Way Catalyst – Composition, active components and function
- Key reactions of the simultaneous oxidation and reduction of pollutants
- Ageing of Three-Way Catalysts

### 4. Catalytic Exhaust Gas Treatment of Gaseous Pollutants from Diesel Engines

- Aftertreatment challenges with a lean diesel exhaust gas
- Diesel oxidation catalysts – Composition and function
- NO<sub>x</sub> storage and reduction catalysts – Composition and function
- Selective catalytic reduction (SCR) – Catalysts and reactions

### 5. Catalytic Exhaust Gas Treatment of Gaseous Pollutants in Lean Burn Gasoline Engines

- General aftertreatment challenges in the lean environment
- Aftertreatment components for lean gasoline exhaust

### 6. Particulate Emission Reduction from Gasoline and Diesel Engines

- Introduction to particulate matter reduction
- Design of modern diesel and gasoline particulate filters
- Basics of filtration theory
- Design of particulate filter systems

## 7. Additional Aftertreatment Technologies

- Hydrocarbon adsorber
- Electric Heaters

## 8. Modeling of Aftertreatment Catalysts and Filters

- One dimensional catalyst and filter model
- Simplified zero dimensional models
- Common reactions considered
- Pressure drop of components
- Simplified filtration model

## 9. Experimental Evaluation of Aftertreatment Components

- Three-way catalysts
- Diesel particulate filters
- Gasoline particulate filters

## 10. Application Examples - Strategies for Component Management in Vehicle Applications

- Lambda control for TWC applications
- Urea dosing strategies for effective SCR
- Soot management for diesel applications
- Soot management for gasoline applications
- On-Board Diagnostics (OBD)
- Influence of fuel and lubricants
- Accumulation of ash in filters
- Aftertreatment considerations in significantly electrified powertrains

## 11. Industrial Manufacturing of Exhaust Gas Aftertreatment Components and Systems

- General design of aftertreatment systems consisting of catalysts and particulate filters
- Manufacturing of ceramic catalyst substrates
- Manufacturing of particulate filters
- Coating of substrates and particulate filters with active catalysts
- Packaging and integration of aftertreatment components into exhaust systems

## Competencies / intended learning achievements

Exhaust gas aftertreatment is an integral part of modern drive concepts. Participants will be introduced to the subject and given an overview of existing exhaust gas aftertreatment technologies for the technical realization of the ultra-low emission levels.

- General problem definition and exhaust gas legislation
- Knowledge on the different catalyst and particulate filter technologies for applications in gasoline and diesel engines
- Basics of the function of catalytic converter systems and particulate filters
- Basics of the selection and design of catalytic converter systems and particulate filters
- Basics of catalyst and filter management in vehicles
- Basic knowledge on manufacturing of exhaust gas catalysts and filter

## Literature

Will be announced in the course

## Materials

Presentation, blackboard

## Requirements for attendance (informal)

Recommend: Basic knowledge of thermodynamics, fluid mechanics and heat & material transfer, lecture "Verbrennungskraftmaschinen" or "Fahrzeugantriebe"/"Vehicle Propulsion Systems" or other lectures covering the basics on internal combustion engines.

### Requirements for attendance (formal)

None

## References to Course [MV-LAF-86335-K-7]

Module	Name	Context
[MV-LAF-M216-M-7 (/mhb/modules/MV-LAF-M216-M-7/)]	Mobile Emission Control Fundamentals for Lowest Emission Concepts	P: 2V, 3.0 Obligatory LP