TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

Module Handbook

TUK MODHB Homapage

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 wuden mit Ausnahme folgender Studiengänge am 28.10.2020, bzw. am 13.01.2021 verabschiedet.

Ausnahmen:

- BEd. Lehramt Metalltechnik (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Bachelor_Lehramt_Metalltechnik.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
- 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
- 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

Module MV-MTS-23-M-4

Measurement and control Theory (M, 8.0 LP)

Module Identification

Module Number	Module Name	CP (Effort)
MV-MTS-23-M-4	*Measurement and control Theory*	8.0 CP (240 h)
MV-MEMT-8-M-6	*Measurement and control Theory*	8.0 CP (240 h)

Hint concerning Module Number MV-MEMT-8-M-6:
Number and Level for Master of Education in Metals Technology

Basedata

CP, Effort	8.0 CP = 240 h
Position of the semester	1 Sem. in WiSe
Level	[4] Bachelor (Specialization)
Language	[DE] German
Module Manager	Seewig, Jörg, Prof. Dr.-Ing. (PROF | DEPT: MV)
Lecturers	Seewig, Jörg, Prof. Dr.-Ing. (PROF | DEPT: MV)
Area of study	[MV-MTS] Measurement and Sensor Technology
Reference course of study	[MV-82.103-SG] B.Sc. Mechanical Engineering
Livecycle-State	[NORM] Active

Courses

Type/SWS	Course Number	Choice in Module-Part	SL	PL	CP	Sem.
2V+1U	**MV-MTS-86600-K-4**	P	-	PL1	4.0	WiSe
3V+1U	**MV-MTS-86602-K-4**	P	-	PL1	4.0	WiSe

- About **[MV-MTS-86600-K-4]**: Title: "Measurement Theory"; Presence-Time: 42 h; Self-Study: 78 h
- About **[MV-MTS-86602-K-4]**: Title: "Control Theory"; Presence-Time: 56 h; Self-Study: 64 h

Examination achievement PL1

- Form of examination: **written exam (Klausur) (180-210 Min.)**
- Examination Frequency: each semester
- Examination number: 10650 ("Measurement and Control Theory")

Evaluation of grades

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

Contents

From [MV-MTS-86600-K-4] Measurement Theory:

- Basic terminology, measurement technology tasks, measuring chain
- Measurement statistics (modeling, probability and distribution functions, confidence interval and complete measurement result, deviation propagation, linear fit and correlation)
- Stationary and dynamic properties of measuring equipment (stationary characteristic measurement curve, compensation methods, spline interpolation and smoothing splines, sensitivity, differential principle)
- Resistance measuring bridges (adjustment procedures, deflection procedures, strain gauges)
- Fourier series and Fourier transformation (derivation, properties, convolution theorem, time frame, examples of applications, filters, carrier frequency procedures)
- Scanning of measurement signals (discrete-time Fourier transformation, aliasing, reconstruction, discrete Fourier transformation)

From [MV-MTS-86602-K-4] Control Theory:

- Fundamentals and modeling of technical systems
- Description of dynamic systems in the time domain (LTI systems, causal systems, differential equations to describe dynamic systems, linearization, block diagrams, solution in time domain, test functions)
- State space representation (normal forms, controllability, observability, stability, homogeneous and particulate solutions)
- Description of dynamic systems in the frequency range (Laplace transformation, transfer function, matrix transfer function, locus, Bode plot, amplitude and phase margin)
- Control circuit (types of recirculation, stationary behavior and lasting offset, stability of control circuit, Nyquist procedure, root locus plot)
- Setting/adjusting controllers (assigning poles, optimum control, heuristic processes)

Competencies / intended learning achievements

From [MV-MTS-86600-K-4] Measurement Theory:

1. Lecture:

Students are able to

- Explain the basic terminology of measurement technology and describe the purpose of measurement technology
- Use statistics to analyze measurement uncertainties and deviations
- Derive stationary properties of measuring equipment on the basis of the characteristic measurement curve
- Demonstrate the benefits of a measuring bridge as well as explain reconciliation and deflection procedures
- Explain and interpret the correlations between time signals and their frequency spectra
- Describe the setup as well as the advantages and disadvantages of the carrier frequency procedure
- Explain scanning of measurement signals

2. Practice:

Students are able to

- Name different distribution functions and compare their application
- Calculate confidence intervals for expectations and variances
- Create characteristic measurement curves through interpolation and approximation methods
- Calculate measuring bridge voltages for reconciliation and deflection procedures
- Calculate and evaluate frequency-modulated signals in the time and frequency range

Apply the scan theorem

From [MV-MTS-86602-K-4] Control Theory:

1. Lecture:

Students are able to

- Explain the properties of LTI systems and causal systems
- Describe systems with differential equations and in the state space
- Explain the controllability, observability and stability of systems
- Demonstrate and explain the correlations between the time and frequency range
- Describe loci and Bode plots
- Name different types of recirculation as well as their advantages and disadvantages
- Motivate and explain pole assignment and optimum control

2. Practice:

Students are able to

- Describe physical systems with differential equations and block diagrams
- Linearize and solve differential equations
- Calculate to answer to physical systems and test functions

- Transform differential equations to the state space
- Check the controllability, observability and stability of systems
- Transform state space representations to normal forms
- Transform the state space representation to the frequency range with the aid of the Laplace transformation and create the matrix transfer function
- Draw loci and Bode plots and then apply them to determine the amplitude and phase margin
- Calculate the lasting offset of control circuits and check the stability of control circuits
- Apply the Nyquist procedure
- Draw and interpret root locus plots
- Calculate control parameters with the aid of the pole assignment, optimum control and heuristic processes

For Bachelor students majoring in education for metallurgy vocational-technical schools:

The students understand the essential fundamentals of measurement and control technology and its application in technology, particularly in the fields relevant for vocational-technical schools, and they can apply the fundamental methodology.

Literature

From [MV-MTS-86600-K-4] Measurement Theory:

- P. Profos: Grundlagen der Messtechnik; Oldenbourg 1997; ISBN 3-486-24148-6
- A. Oppenheim, A. Willsky: Signals and Systems; Prentice Hall 1997; ISBN 0-13-814757-4

From [MV-MTS-86602-K-4] Control Theory:

- Otto Föllinger; Regelungstechnik Einführung in die Methoden und ihre Anwendungen; Heidelberg 1992 ; ISBN 3-7785-2136-5
- Martin Horn; Regelungstechnik: rechnergestützter Entwurf zeitkontinuierlicher und zeitdiskreter Regelkreise; Pearson Studium 2004; ISBN 3-8273-7059-0

Requirements for attendance of the module (informal)

Recommended prior knowledge from the following modules:

Modules:

- [MAT-00-01-M-1] Higher Mathematics I (M, 8.0 LP)
- [MAT-00-02-M-1] Higher Mathematics II (M, 8.0 LP)
- [MV-MTS-B102-M-4] Electrical Engineering for Mechanical Engineering (M, 7.0 LP)

Requirements for attendance of the module (formal)

None

References to Module / Module Number [MV-MEMT-8-M-6]

Course of Study	Section	Choice/Obligation
[MV-66.108-SG] M.Ed. LaBBS Metals Technology	[Core Modules (non specialised)] Maschinen- und Fahrzeugtechnik	[P] Compulsory

References to Module / Module Number [MV-MTS-23-M-4]

Course of Study	Section	Choice/Obligation
[MV-82.103-SG] B.Sc. Mechanical Engineering	[Core Modules (non specialised)] Ingenieurwissenschaftliche Grundlagen II (IWG II)	[P] Compulsory
[WIW-82.179-SG#2009] B.Sc. Business Administration and Engineering specialising in Mechanical Engineering (2009) [2009]	[Fundamentals] Field of study: Mechanical Engineering	[P] Compulsory
[MV-82.814-SG] B.Sc. Mechanical Engineering with a minor in Economics	[Core Modules (non specialised)] Ingenieurwissenschaftliche Grundlagen II	[P] Compulsory
[MV-82.A29-SG] B.Sc. Biological and Chemical Engineering	[Fundamentals] Ingenieurwissenschaftliche Grundlagen	[P] Compulsory
[MV-82.B10-SG] B.Sc. Energy and Process Engineering	[Core Modules (non specialised)] Ingenieurwissenschaftliche Grundlagen II	[P] Compulsory
[PHY-82.B90-SG] B.Sc. TechnoPhysics	[Compulsory Modules] Grundlagen des Maschinenbaus	[P] Compulsory
[MAT-88.105-SG] M.Sc. Mathematics	[Subsidiary Topic] Subsidiary Topic (Minor)	[WP] Compulsory Elective
[MAT-88.118-SG] M.Sc. Industrial Mathematics	[Subsidiary Topic] Subsidiary Topic (Minor)	[WP] Compulsory Elective
[WIW-88.?-SG#2022] M.Sc. Business Administration and Engineering specialising in Mechanical Engineering (2022) [2022]	[Specialisation] Field of Study: Mechanical Engineering	[P] Compulsory