Modulhandbuch für
Production Systems Engineering (M.Sc.)

Content / Inhaltsverzeichnis

Module Handbook: Production Systems Engineering (M.Sc.)

Prüfungsordnungsbeschreibung: Production Systems Engineering (M.Sc.)

Title **Titel**	Production Systems Engineering (M.Sc.)
Sub-Title **Untertitel**	Production Systems Engineering

Compulsory Courses

Module (Modul): Manufacturing Technology II

Module **Modulbezeichnung**	Manufacturing Technology II
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MT II
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Klocke, Fritz
Lecturer **Dozenten**	Klocke, Fritz
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Compulsory Module Pflichtmodul
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	6
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	None
Learning Objectives **Angestrebte Lernergebnisse**	**Manufacturing Technology II** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) have an extended understanding in technologically comprehensive topics like material science and tribology. b) know and understand the mechanisms to improve the performance of powder metallurgical, cutting, forming and hybrid processes. <u>Abilities / Skills:</u> *Students* a) apply this knowledge properly and are able to assess manufacturing processes with regard to near surface damages and functional surfaces.

	b) are able to evaluate processes by calculation of key figures for productivity, profitability and reliability und thus are able to propose solutions. Competences: *Students* a) critically analyze company decisions with technological background and are able to communicate the assessments also to a non-specialist audience. b) are familiar with the latest trends in seminal branches like optical components, mobility and tool making.
Content **Inhalt**	**Manufacturing Technology II** • Metal-based Materials • Tool Materials • Powder Metallurgy • Tribology • Near Surface Damages and Functional Surfaces • High-Speed Machining • Bulk and Sheet Metal Forming • Computer-aided Technology Planning • Hybrid Manufacturing Methods • Productivity and Profitability • Manufacturing of Optical Components • Manufacturing of Components for Mobility • Manufacturing Methods for Toolmaking
Media **Medienform**	e-Learning L^{2}P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Manufacturing Technology	MSPSE	6	0	0	0	90
Lecture (Vorlesung): Manufacturing Technology	MSPSE	0	90	30	60	
Exercise (Übung): Manufacturing Technology	MSPSE	0	90	30	60	

Teaching Unit / Examinations: Examination Manufacturing Technology II
Studien-/Prüfungsleistung: Prüfung Manufacturing Technology II

Title **Titel**	Examination Manufacturing Technology II Prüfung Manufacturing Technology II
Sub-title **Untertitel**	MT II
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Teaching Unit / Examinations: Lecture Manufacturing Technology II
Studien-/Prüfungsleistung: Vorlesung Manufacturing Technology II

Title **Titel**	Lecture Manufacturing Technology II Vorlesung Manufacturing Technology II
Sub-title **Untertitel**	V MT II
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung
Teaching Unit / Examinations: Exercise Manufacturing Technology II **Studien-/Prüfungsleistung: Übung Manufacturing Technology II**	
Title **Titel**	Exercise Manufacturing Technology II Übung Manufacturing Technology II
Sub-title **Untertitel**	Ü MT II
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Module (Modul): Production Management B

Module **Modulbezeichnung**	Production Management B
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	PM
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Schuh, Günther
Lecturer **Dozenten**	Schuh, Günther
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Compulsory Module Pflichtmodul
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 150h, Contact hours 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	none
Learning Objectives **Angestrebte Lernergebnisse**	**Production Management B** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) know and understand particular aspects of the domains design, process planning, production as well as program planning and investment planning; b) understand the usefulness of modern planning methods, with emphasis on the application of computers (CAD, CAP, CAM etc.; c) Practical examples offer the possibility to understand the boundary conditions in daily business and give the students an advanced and comprehensive basis to reflect advantages and disadvantages of the discussed systems <u>Abilities / Skills:</u> *Students* a) analyse the structure of enterprise resources, make comparisons and give recommendations according to the results of the analysis

Content **Inhalt**	**Production Management B** • IT in Production Management • Customer Relations Management • Enterprise Resource Planning I • Enterprise Resource Planning II • Enterprise Resource Planning III • Supply Chain Management I • Supply Chain Management II • Product Lifecycle Management I • Product Lifecycle Management II • Product Lifecycle Management III • Digital Plant Planning and Simulation • Business Engineering - Method of selecting IT-Systems
Media **Medienform**	e-Learning L^{2}P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Production Management B	MSPSE	5	0	0	0	90
Lecture (Vorlesung): Production Management B	MSPSE	0	75	30	45	
Exercise (Übung): Production Management B	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Production Management B **Studien-/Prüfungsleistung: Prüfung Production Management B**	
Title **Titel**	Examination Production Management B Prüfung Production Management B
Sub-title **Untertitel**	PM B
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung
Teaching Unit / Examinations: Lecture Production Management B **Studien-/Prüfungsleistung: Vorlesung Production Management B**	
Title **Titel**	Lecture Production Management B Vorlesung Production Management B
Sub-title **Untertitel**	V PM B
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung
Teaching Unit / Examinations: Exercise Production Management B **Studien-/Prüfungsleistung: Übung Production Management B**	
Title	Exercise Production Management B

Titel	Übung Production Management B
Sub-title **Untertitel**	Ü PM B
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Module (Modul): Welding and Joining Technologies

Module **Modulbezeichnung**	Welding and Joining Technologies
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	WJT
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Reisgen, Uwe
Lecturer **Dozenten**	Reisgen, Uwe
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Compulsory Module Pflichtmodul
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	6
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Welding and Joining Technologies** Welding is an interdisciplinary technology. All fields of industrial manufacturing require the joining of individual parts to functional groups. Many welding and cutting technologies are applicable for this purpose. After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) understand the main welding technologies and know how to critically review the shown welding technologies <u>Abilities / Skills:</u> *Students* a) are capable to select the suitable welding technologies for a welding task and to substantiate the selection by specifying the advantages and the disadvantages of the individual methods

Content **Inhalt**	**Welding and Joining Technologies** • Introduction • Welding of steel • Gas Fusion Welding • Manual Metal Arc Welding • Submerged Arc Welding • TIG Welding • Plasma Welding • MIG Welding • Electro Gas Welding • Electro Slag Welding • Pressure Welding • Resistance Welding • Electron Beam Welding • Laser Beam Welding • Special Processes • Mechanization / Automation • Sensor Technology • Brazing • Mechanical Joining / Adhesive Bonding • Design and Calculation
Media **Medienform**	e-Learning L^{2}P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Welding and Joining Technologies	MSCAME-2103.a/12	6	0	0	0	120
Lecture (Vorlesung): Welding and Joining Technologies	MSCAME-2103.b/12	0	90	30	60	
Exercise (Übung): Welding and Joining Technologies	MSCAME-2103.c/12	0	90	30	60	

Teaching Unit / Examinations: Examination Welding and Joining Technologies
Studien-/Prüfungsleistung: Prüfung Welding and Joining Technologies

Title **Titel**	Examination Welding and Joining Technologies Prüfung Welding and Joining Technologies
Sub-title **Untertitel**	WJT
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module Semestervariable Wahlleistung

Teaching Unit / Examinations: Lecture Welding and Joining Technologies
Studien-/Prüfungsleistung: Vorlesung Welding and Joining Technologies

Title **Titel**	Lecture Welding and Joining Technologies Vorlesung Welding and Joining Technologies
Sub-title **Untertitel**	V WJT
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module Semestervariable Wahlleistung
Teaching Unit / Examinations: Exercise Welding and Joining Technologies **Studien-/Prüfungsleistung: Übung Welding and Joining Technologies**	
Title **Titel**	Exercise Welding and Joining Technologies Übung Welding and Joining Technologies
Sub-title **Untertitel**	Ü WJT
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Compulsory module Semestervariable Wahlleistung

Module (Modul): Quality Management

Module **Modulbezeichnung**	Quality Management
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	QM
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Schmitt, Robert
Lecturer **Dozenten**	Schmitt, Robert
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Compulsory Module Pflichtmodul
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	6
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none
Learning Objectives **Angestrebte Lernergebnisse**	**Quality Management** Due to the growing importance of quality assurance in industrial production and economy, the lecture "Quality Management" was initiated at the Faculty of Production Engineering. Quality issues of industrial applications and necessary underlying theories are emphasized during the course of this lecture. It is the main aim of this lecture to present the students with the abstract concept of *quality*, its importance and social relevance, possible organizational forms of quality systems and relating quality management methods and tools. During the turn, a broader perspective can also be given via discussions about more advanced and detailed topics such as strategic quality planning, balancing quality costs and quality related legal questions. After successfully completing this course, the student will have acquired the following learning outcomes: Knowledge / Understanding: The students… *Students* a) understand the abstract concept of quality; b) know the standards (norms);

	c) understand main quality issues of industrial applications; d) know necessary underlying management theories; e) understand essential quality tools, their function, the benefit and their interdependence; f) know the organization of management systems; g) know the organization of quality systems Abilities / Skills: The students… *Students* a) have deepen their statistic knowledge; b) have improved their computer skills; c) have improved their economic thinking; d) analyse problematic quality issues: e) apply tools to contexts Competencies: The students… *Students* a) critically assess topics such as quality planning, quality costs and quality legal questions via discussions; b) critically reflect approaches, methods and guiding principles while communicating their opinions
Content **Inhalt**	**Quality Management** ***01 Introduction:*** • The concept of *quality*, Quality Management structures, poor quality and defects, Deming-Chain, quality improvement and failure prevention ***02 Normative QM Systems:*** • Total Quality Management (TQM), normative quality management standards, implementation of quality management systems, auditing and certification concepts ***03 Strategic Quality Programs:*** • Strategic Quality Programs, EFQM, RADAR, Six Sigma, Sigma Levels, ACQMM (Aachener QM Modell) , Quality Stream (Basic statistics in the exercise) ***04 Quality and Economics:*** • Quality controlling, quality cost accounting, cost-related process performance, cost-related quality performance indicators, balanced scorecard, target costing ***05 QM in Field Data Evaluation:*** • Field Data analysis, Weibull-Analysis, Isochron-Diagram, MIS-Diagram ***06 QM in Manufacturing:*** • Statistical Process Control, 5S, Value Stream Mapping ***07 QM in the Early Phases - Focus Product:*** • Kano-Model, Quality Function Deployment (QFD), House of Quality, TRIZ ***08 QM in the Early Phases - Focus Process:*** • Process Optimization , Design of Experiments (DoE), Factorial Designs, Shainin Methodology ***09 QM in the Early Phases - Deviation:*** • Design Review, Quality Assessment, Fault Tree Analysis, FMEA, DRBFM, Rapid Quality Deployment ***10 QM in the Procurement:*** • Procurement Strategies, supplier selection, incoming inspection, accepted quality level ***11 Quality and Information:*** • Quality control loops, quality data basis, Computer Aided Quality Management (CAQ), computer-aided test planning, implementation of CAQ systems

	12 QM in Service Industries: • Service Engineering, Service Level Agreement, Service Blueprinting, ServQual, Vignette Techniques, Service FMEA, Conjoint Analyses
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Quality Management	MSPSE	6	0	0	0	240
Lecture (Vorlesung): Quality Management	MSPSE	0	90	30	60	
Exercise (Übung): Quality Management	MSPSE	0	90	30	60	

Teaching Unit / Examinations: Examination Quality Management
Studien-/Prüfungsleistung: Prüfung Quality Management

Title **Titel**	Examination Quality Management Prüfung Quality Management
Sub-title **Untertitel**	QM
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Teaching Unit / Examinations: Lecture Quality Management
Studien-/Prüfungsleistung: Vorlesung Quality Management

Title **Titel**	Lecture Quality Management Vorlesung Quality Management
Sub-title **Untertitel**	V QM
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Teaching Unit / Examinations: Exercise Quality Management
Studien-/Prüfungsleistung: Übung Quality Management

Title **Titel**	Exercise Quality Management Übung Quality Management
Sub-title **Untertitel**	Ü QM
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Module (Modul): German Language Course

Module **Modulbezeichnung**	German Language Course
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	GLC
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Variable
Lecturer **Dozenten**	Variable
Language **Sprache**	deutsch
Assignment to the curriculum **Zuordnung zum Curriculum**	Sprachenzentrum/Sprachenzentrum/Deutsch als Fremdsprache/Semesterkurse/ Stufe A1 GER
Teaching form **Lehrformen**	Written examination, Lecture/Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	6
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**German Language** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) Communicate basic knowledge on German Culture and Cultural Studies; b) German classes enable one to accomplish everyday communication within university surroundings (dormitory, cafeteria etc.); c) German classes offer prerequisites for culturally adequate application documents for internships (CV, letter of motivation); <u>Abilities /Skills:</u> *Students* a) Communicate insight into cultural situations at German universities
Content **Inhalt**	**German Language** • Getting to know someone • Introducing oneself • City explorations

	• Orientation in the city • Techniques: learning and remembering words • Buying groceries • Communication on the phone • Techniques: learning grammar systematically • Calendar, festivities • Holidays • Learning and forgetting • Learning psychology • German newspapers • Reading habits • When in Rome, do as the Romans do • Intercultural experience • Media • Geographic German studies • Inventions and progress • Between cultures • Environmental protection/problems • Project Europe • Job market Germany • Applications • CVs
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): German Language Course	MSPSE	6	0	0	0	120
Lecture/Exercise (Vorlesung/Übung): German Language Course	MSPSE	0	180	60	120	

Teaching Unit / Examinations: Examination German Language Course **Studien-/Prüfungsleistung: Prüfung German Language Course**	
Title **Titel**	Lecture/Exercise German Language Course Prüfung German Language Course
Sub-title **Untertitel**	GLC
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung
Teaching Unit / Examinations: Lecture/Exercise German Language Course **Studien-/Prüfungsleistung: Vorlesung/Übung German Language Course**	
Title **Titel**	Lecture/Exercise German Language Course Vorlesung/Übung German Language Course
Sub-title **Untertitel**	VÜ GLC
Semester **Studiensemester**	1
Connection to the curriculum	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Curriculare Verankerung	

Module (Modul): Master Thesis

Module **Modulbezeichnung**	Master Thesis
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	Master Thesis
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	3
Person in Charge **Modulverantwortliche**	Variable
Lecturer **Dozenten**	Variable
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Compulsory Module Plichtmodul
Teaching form **Lehrformen**	
Workload **Arbeitsaufwand**	Total 6 months Gesamt 6 Monate
Lecture hours **Kontaktzeit (SWS)**	0
ECTS-Credit Points (CP) **Kreditpunkte**	30
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	Mandatory: • 45 ECTS
Learning Objectives **Angestrebte Lernergebnisse**	**Master Thesis** The students learn the independent approach and processing of academic themes, their documentation and written interpretation within a set deadline. They acquire systematic academic research skills.
Content **Inhalt**	**Master Thesis** Completed academic paper which shall show that the students are capable of independently processing a problem related to their subject according to academic methods within a set deadline. Wissenschaftliche abgeschlossene Arbeit, die zeigen soll, dass die Studierenden in der Lage sind, ein Problem aus einem in Beziehung zu ihrem stehenden Fach in begrenzter Frist selbstständig nach wissenschaftlichen Methoden zu bearbeiten.
Media **Medienform**	
Literature **Literatur**	

Teaching Unit / Examinations: Master Thesis and Master Thesis Kolloquium
Studien-/Prüfungsleistung: Master Thesis and Master Thesis Kolloquium

Title **Titel**	**ECTS**	**Workload**	**Lecture H.**	**Self-study**	**Duration of Exam**

	Kredit-punkte	Arbeits-aufwand (h)	Kontakt-zeit (h)	Selbst-studium (h)	Prüfungsdauer (min)
Master Thesis (Masterarbeit) Title	28	0	0	0	0
Master´s Thesis defense colloquium (Masterarbeitskolloquium)	2	0	0	0	30-60

Teaching Unit / Examinations: Master Thesis and Master Thesis Kolloquium **Studien-/Prüfungsleistung: Master Thesis and Master Thesis Kolloquium**	
Title **Titel**	Master Thesis and Master Thesis Kolloquium
Sub-title **Untertitel**	MastThesis
Semester **Studiensemester**	3
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Module (Modul): Gear and Transmission Technology

Module **Modulbezeichnung**	Gear and Transmission Technology
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	GTT
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Brecher, Christian Klocke, Fritz
Lecturer **Dozenten**	Brecher, Christian Klocke, Fritz
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Compulsory Module Pflichtmodul
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	6
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Gear and Transmission Technology** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) learn about the requirements on modern gears b) know the basics of calculation and test methods that are used in the development process of gears c) understand how test rigs for fatigue and gear noise tests will be introduced. d) get knowledge about the gear production and the machine tools for gear production. <u>Abilities / Skills:</u> *Students* a) gain experience in simulation techniques in gear design and corresponding manufacturing processes. b) gain experience in the analysis of gear tests.

Content **Inhalt**	**Gear and Transmission Technology** Introduction • Gear Geometry - Spur Gears • Damage of gears • Basics of the gear development process I • Basics of the gear development process II • Investigation of gears - Fatigue tests • Investigation of gears - Running behavior • Gear Production • Gear Production – Finishing • Machine Tools for Gear Production • Simulation • Gear Geometry - Bevel Gears • Special Gears, Beveloids
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	Lecture script

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Gear and Transmission Technology	MSPSE	6	0	0	0	120
Lecture/Exercise (Vorlesung/Übung): Gear and Transmission Technology	MSPSE	0	90	30	60	
Exercise (Übung): Gear and Transmission Technology	MSPSE	0	90	30	60	

Teaching Unit / Examinations: Examination Gear and Transmission Technology
Studien-/Prüfungsleistung: Prüfung Gear and Transmission Technology

Title **Titel**	Examination Gear and Transmission Technology Prüfung Gear and Transmission Technology
Sub-title **Untertitel**	
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module Semestervariable Wahlleistung

Teaching Unit / Examinations: Lecture Gear and Transmission Technology
Studien-/Prüfungsleistung: Vorlesung Gear and Transmission Technology

Title **Titel**	Lecture Gear and Transmission Technology Vorlesung Gear and Transmission Technology
Sub-title **Untertitel**	
Semester **Studiensemester**	1

Connection to the curriculum **Curriculare Verankerung**	Compulsory module Semestervariable Wahlleistung
Teaching Unit / Examinations: Exercise Gear and Transmission Technology **Studien-/Prüfungsleistung: Übung Gear and Transmission Technology**	
Title **Titel**	Lecture Gear and Transmission Technology Vorlesung Gear and Transmission Technology
Sub-title **Untertitel**	
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module Semestervariable Wahlleistung

Module (Modul): Mechatronics and Control Techniques for Production Plants

Module **Modulbezeichnung**	Mechatronics and Control Techniques for Production Plants
Modul level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MCP
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Brecher, Christian
Lecturer **Dozenten**	Brecher, Christian
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Compulsory Module Pflichtmodul
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 180h, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours / Contact hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	6
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Mechatronics and Control Techniques for Production Plants** Students get familiar with the structure, the design and the engineering process of mechatronic systems. After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) understand the characteristics of the behavior and control of feed axes in machine tools; b) know different types of sensors and their application within machine tools <u>Abilities / Skills:</u> a) apply this knowledge to create control programs in different programming tools b) get to know the essential features and applications of logical, numerical and motion controls of machines
Content **Inhalt**	**Mechatronics and Control Techniques for Production Plants**

	Introduction to Mechatronics and control for production - Overview of mechatronic systems - Construction of feed drives *Information processing in mechatronic systems* - Theory and examples of embedded systems - Programmable logic circuits *Measurement systems and sensors* - Position and angle measuring systems - Acceleration and vibration measurement *Mechanical control* - Single and multi-spindle turning machines - Further developments *Gripping technology* - Gripping principles - Sensor technology and applications *Position control of feed drives* - Control concept of a machine axis - Accuracy and synchronous control of multi-axis *Numerical Control 1: structure, programming, CAM* - Construction of NC controls - NC programming process *Numerical Control 2: Interpolation* - Kinematic transformations and compensations - Interpolation *Industrial robots and handling systems, robot control* - Structure and kinematic transformations - RC programming *Programmable Logic Control (PLC) and motion control (MC)* - Basics of Information Processing - Programmable Controllers *Signal processing, process and condition monitoring* - Tasks of process and condition monitoring - Use of sensors and signal processing *Mechatronic Engineering, Simulation environments for virtual commissioning* - Basics of modeling of mechatronic systems - Behavior modeling and data management - Introduction: complexity of software and systems
Media **Medienform**	e-Learning L^{2}P, Power Point
Literature **Literatur**	Lecture Notes Students also receive a list of relevant literature

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-Study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Mechatronics and Control Techniques for Production Plants	MSPSE	6	0	0	0	120

Lecture (Vorlesung): Mechatronics and Control Techniques for Production Plants	MSPSE	0	90	30	60	0
Exercise (Übung): Mechatronics and Control Techniques for Production Plants	MSPSE	0	90	30	60	0

Teaching Unit / Examinations: Mechatronics and Control Techniques for Production Plants **Studien-/Prüfungsleistung: Prüfung Mechatronics and Control Techniques for Production Plants**	
Title **Titel**	Examination Mechatronics and Control Techniques for Production Plants Prüfung Mechatronics and Control Techniques for Production Plants
Sub-title **Untertitel**	Examination MCP Prüfung MCP
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung
Teaching Unit / Examinations: Examination Mechatronics and Control Techniques for Production Plants **Studien-/Prüfungsleistung: Prüfung Mechatronics and Control Techniques for Production Plants**	
Title **Titel**	Lecture Mechatronics and Control Techniques for Production Plants Vorlesung Mechatronics and Control Techniques for Production Plants
Sub-title **Untertitel**	Lecture MCP Vorlesung MCP
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung
Teaching Unit / Examinations: Examination Mechatronics and Control Techniques for Production Plants **Studien-/Prüfungsleistung: Prüfung Mechatronics and Control Techniques for Production Plants**	
Title **Titel**	Exercise Mechatronics and Control Techniques for Production Plants Übung Mechatronics and Control Techniques for Production Plants
Sub-title **Untertitel**	Exercise MCP Übung MCP
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Compulsory module (variable to the semester) Semestervariable Pflichtleistung

Elective Courses

Module (Modul): Control Engineering

Module **Modulbezeichnung**	Control Engineering
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	CE
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Abel, Dirk
Lecturer **Dozenten**	Abel, Dirk
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Oral Examination, Exercise, Lecture Mündliche Prüfung (MP), Übung (Ü), Vorlesung (V)
Workload **Arbeitsaufwand**	Total 90h, Contact hours 60h, Self-study 30h Gesamt 90 h, Kontaktzeit 60 h, Selbststudium 30 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	3
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	Basic knowledge in mathematics as defined in the examination regulations.
Learning Objectives **Angestrebte Lernergebnisse**	**Control Engineering** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) know, recognize and classify the most common linear control loop elements b) the effects of feedback and apply different methods to set up feedback elements (controllers) such that predefined control goals are met <u>Abilities / Skills:</u> a) to analyze dynamical, biological and biomedical systems and identify the relevant causalities b) to employ different mathematical descriptions of dynamical systems c) solve differential equations by means of Laplace transform d) assess of the stability of dynamical systems using different methods e) obtain, interpret and employ the frequency response of dynamical systems

Content **Inhalt**	**Control Engineering** Significance of control theory, examples of biological and biomedical control loops, functional diagrams, linearization, set up and solving of differential equations, stability, features in time domain of dynamical systems, Laplace transform, transfer function, frequency response, functional diagram algebra, features in frequency domain of dynamical systems, bode diagram, Nyquist plot, Linear control loop elements, principle and goals of controller design, algebraic stability criteria, steady state analysis and transient performance of a control loop, controller setting rules, Nyquist stability criterion, phase margin, gain margin, controller design in bode diagram.
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Control Engineering	MSPSE	3	0	0	0	120
Lecture (Vorlesung): Control Engineering	MSPSE	0	45	30	15	
Exercise (Übung): Control Engineering	MSPSE	0	45	30	15	

Teaching Unit / Examinations: Examination Control Engineering **Studien-/Prüfungsleistung: Prüfung Control Engineering**	
Title **Titel**	Examination Control Engineering Prüfung Control Engineering
Sub-title **Untertitel**	CE
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung
Teaching Unit / Examinations: Lecture Control Engineering **Studien-/Prüfungsleistung: Vorlesung Control Engineering**	
Title **Titel**	Lecture Control Engineering Vorlesung Control Engineering
Sub-title **Untertitel**	V CE
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung
Teaching Unit / Examinations: Exercise Control Engineering **Studien-/Prüfungsleistung: Übung Control Engineering**	
Title **Titel**	Exercise Control Engineering Übung Control Engineering
Sub-title **Untertitel**	Ü CE
Semester	1

Studiensemester	
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Module (Modul): High Precision Glass Optics Manufacturing

Module **Modulbezeichnung**	High Precision Glass Optics Manufacturing
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	HPGOM
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Klocke, Fritz
Lecturer **Dozenten**	Klocke, Fritz
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written or Oral Examination, Exercise, Lecture Schriftliche oder Mündliche Prüfung, Übung, Vorlesung
Workload **Arbeitsaufwand**	Total 150h, Contact hours 60h, Self-study 90 h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**High Precision Glass Optics Manufacturing** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) Know and understand the demands on precision components. b) Know and understand the specialities of glass in comparison to other materials. c) Know and understand direct machining and replication methods for complex optical lens production. d) Know and understand the characteristics of ultra-precision machine tools for machining optical components. e) Understand the measurement methods that are established in ultra-precision shape, surface and rim zone characterization. <u>Abilities / Skills:</u> a) Apply this knowledge and are able to assess manufacturing processes, machine tools and metrology methods with regard to the demands of optical components. b) Are able to evaluate production strategies for higher quality, higher output, higher complexity and lower costs.

	c) Critically analyze company decisions with a technological background and communicate the assessments to non-specialist audiences. d) Are familiar with the latest production trends in the seminal optics branch.
Content **Inhalt**	**High Precision Glass Optics Manufacturing** LE 1 (Introduction): Clear overview on the topic and the following courses, Application cases, Awareness for the need of high precision optics LE 2 (Machine Aspects): Awareness of requirements on UP machines in comparison to non-UP machines, tribological aspects, error origins/impacts/compensation strategies LE 3 (Grinding I): Awareness of the needs of grinding, machining, distinction between brittle and ductile machining, rendition of ELID sequencesLE 4 (Grinding II): Classification of different materials regarding their machinability by grinding, grinding wheel indications, assign wheel composition to the application LE 5 (Polishing of glass optics I): Distinction between grinding, polishing, lapping and honing, working principle, influence on the removal rate LE 6 (Polishing of glass optics II): Full-aperture, sub-aperture and corrective polishing, corrective polishing principles, mechanical and chemo-mechanical polishing LE 7 (Diamond Turning): Distinction between grinding/polishing and diamond turning, achievable accuracy, impossibility of direct steel SPDT, wear mechanisms and prevention LE 8 (Coatings): Coatings and their applications, optical and wear protective coatings, differences between coating technologies, AR-coatings, wear mechanisms and prevention LE 9 (Modeling): Simulation assistance in molding processes, concepts/mathematics, chances and limits, critical interpretation of simulation results LE 10 (Non-isothermal Glass Molding): Precision and efficiency, working principle, heat transfer mechanisms, knowledge of wear phenomena and influence sources LE 11 (Precision Glass Molding): Classifying PGM regarding precision and efficiency, understanding of the working principle (temperatures, motions, etc.) esp. in comparison to NGM, Knowledge of wear phenomena and influence sources LE 12 (Metrology): Measuring principles and application, complex shape measurements, tactile and non-tactile shape qualification, interferometry, validity of measuring results LE 13 (Application Case): Recapitulation of the »big picture«, approaching manufacturing problems systematically, evaluation of direct or replicative manufacturing depending on applications and markets
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): High Precision Glass Oprics Manufacturing	MSPSE	5	0	0	0	120
Lecture (Vorlesung): High Precision Glass Oprics Manufacturing	MSPSE	0	75	30	45	
Exercise (Übung): High Precision Glass Oprics Manufacturing	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination High Precision Glass Oprics Manufacturing
Studien-/Prüfungsleistung: Prüfung High Precision Glass Oprics Manufacturing

Title **Titel**	Examination High Precision Glass Oprics Manufacturing Prüfung High Precision Glass Oprics Manufacturing
Sub-title **Untertitel**	P HPGOM

Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung
Teaching Unit / Examinations: Lecture High Precision Glass Oprics Manufacturing **Studien-/Prüfungsleistung: Vorlesung High Precision Glass Oprics Manufacturing**	
Title **Titel**	Lecture High Precision Glass Oprics Manufacturing Vorlesung High Precision Glass Oprics Manufacturing
Sub-title **Untertitel**	V HPGOM
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung
Teaching Unit / Examinations: Exercise High Precision Glass Oprics Manufacturing **Studien-/Prüfungsleistung: Übung High Precision Glass Oprics Manufacturing**	
Title **Titel**	Exercise Control Engineering Übung Control Engineering
Sub-title **Untertitel**	Ü HPGOM
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Module (Modul): Mechatronics of Forming Processes

Module **Modulbezeichnung**	Mechatronics of Forming Processes
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MFP
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Markert, Bernd
Lecturer **Dozenten**	Markert, Bernd
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written or Oral Examination, Exercise, Lecture Schriftliche oder Mündliche Prüfung, Übung, Vorlesung
Workload **Arbeitsaufwand**	Total 150h, Contact hours 60h, Self-study 90 h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Mechatronics of Forming Processes** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) Understand the theoretical backgrounds of forming processes and plasticity. b) Know state-of-the-art metal forming processes such as sheet bending, cupping, drawing, hydroforming, detonation forming, spinning, rolling, closed die forging and extrusion. c) Know analytical and numerical modelling techniques in forming (e.g. slab analysis, upper bound analysis, finite element method). d) Understand the challenges of the modelling of forming processes and know the limitations of the modelling techniques (e.g. numerical instabilities) e) Be aware of ongoing research questions in metal forming <u>Abilities / Skills:</u> a) Develop mechanical models for describing forming processes b) Select the appropriate modelling technique for a given forming problem c) Determine the right level of model complexity for efficient and reliable simulation

	d) Determine load and motion requirements for forming machines/processes
Content **Inhalt**	**Mechatronics of Forming Processes** 1. Introduction to forming: common industrial metal forming processes and main challenges related to modelling 2. Review of continuum mechanics basics and tensor calculus, kinematic and balance relations 3. Constitutive models of plastic deformation and material properties 4. Boundary conditions: e.g. friction and lubrication, heat transfer, applied loading 5. Analytical methods in forming: e.g. Slab analysis, upper bound method, slip line field analysis 6. Numerical methods in forming: e.g. finite element method, finite difference method 7. Modelling of industrial forming processes demonstrated by examples 8. Ongoing research questions in metal forming 9. Case study e.g. high-speed forming
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Mechatronics of Forming Processes	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Mechatronics of Forming Processes	MSPSE	0	75	30	45	
Exercise (Übung): Mechatronics of Forming Processes	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Mechatronics of Forming Processes
Studien-/Prüfungsleistung: Prüfung Mechatronics of Forming Processes

Title **Titel**	Examination Mechatronics of Forming Processes Prüfung Mechatronics of Forming Processes
Sub-title **Untertitel**	P MFP
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Teaching Unit / Examinations: Lecture Mechatronics of Forming Processes
Studien-/Prüfungsleistung: Vorlesung Mechatronics of Forming Processes

Title **Titel**	Lecture Mechatronics of Forming Processes Vorlesung Mechatronics of Forming Processes
Sub-title **Untertitel**	V MFP
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Teaching Unit / Examinations: Exercise Mechatronics of Forming Processes **Studien-/Prüfungsleistung: Übung Mechatronics of Forming Processes**	
Title **Titel**	Exercise Control Engineering Übung Control Engineering
Sub-title **Untertitel**	Ü M
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Module (Modul): Molecular Mechanics and Multiscale Modelling of Materials

Module **Modulbezeichnung**	Molecular Mechanics and Multiscale Modelling of Materials
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MMMMM
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Markert, Bernd
Lecturer **Dozenten**	Markert, Bernd
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written or Oral Examination, Exercise, Lecture Schriftliche oder Mündliche Prüfung, Übung, Vorlesung
Workload **Arbeitsaufwand**	Total 150h, Contact hours 60h, Self-study 90 h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Molecular Mechanics and Multiscale Modelling of Materials** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) understand the theoretical background of both methods, molecular dynamics and continuum mechanics b) are able to compute mechanical properties at molecular level - reproduce molecular material behaviour at macroscopic level c) perform multi-scale modelling of hierarchical bio-materials d) modelling of fracture at atomistic scale <u>Abilities / Skills:</u> a) able to deal with molecular dynamics simulations at nano-scale level b) perform FEM simulations at macro-scale by using nano-scale mechanical properties c) able to perform bottom-up approach in efficient way d) knowledge of fracture at nano-scale as well as macro-scale

	Competence: e) able to deal with interdisciplinary field problems, e. g., nano-scale MD simulations and macro-scale FEM simulations f) use the knowledge to explore naturally available hierarchical materials, which outperform artificial materials in terms of mechanical properties g) apply contents of the lecture to natural as well as artificial materials
Content **Inhalt**	**Molecular Mechanics and Multiscale Modelling of Materials** Introduction to multi-scale modelling Molecular dynamics - Theoretical background of molecular dynamics - Force-probe molecular dynamics simulations - Compute mechanical properties at molecular level Phase field modelling (finite element modelling) - Theoretical background - Reproduce molecular mechanical properties - Validations - Multi-scale modelling - Scale bridging - Bottom-up approach - Applications, e.g., spider silk, nacre Exercises: - Molecular dynamics simulations - Force-probe molecular dynamics simulations - Compute mechanical properties at molecular level, e.g., Young's modulus - Finite element simulations based on force-probe molecular dynamics simulations - Validations - Analysis of multi-phasic materials
Media **Medienform**	e-Learning L^{2}P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Molecular Mechanics and Multiscale Modelling of Materials	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Molecular Mechanics and Multiscale Modelling of Materials	MSPSE	0	75	30	45	
Exercise (Übung): Molecular Mechanics and Multiscale Modelling of Materials	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Molecular Mechanics and Multiscale Modelling of Materials
Studien-/Prüfungsleistung: Prüfung Molecular Mechanics and Multiscale Modelling of Materials

Title **Titel**	Examination Molecular Mechanics and Multiscale Modelling of Materials Prüfung Molecular Mechanics and Multiscale Modelling of Materials
Sub-title **Untertitel**	P MMMMM

Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung
Teaching Unit / Examinations: Lecture Mechatronics of Forming Processes **Studien-/Prüfungsleistung: Vorlesung Mechatronics of Forming Processes**	
Title **Titel**	Lecture Mechatronics of Forming Processes Vorlesung Mechatronics of Forming Processes
Sub-title **Untertitel**	V MMMMM
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung
Teaching Unit / Examinations: Exercise Molecular Mechanics and Multiscale Modelling of Materials **Studien-/Prüfungsleistung: Übung Molecular Mechanics and Multiscale Modelling of Materials**	
Title **Titel**	Exercise Molecular Mechanics and Multiscale Modelling of Materials Übung Molecular Mechanics and Multiscale Modelling of Materials
Sub-title **Untertitel**	Ü MMMMM
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Module (Modul): Selected Topics of Inelasticity Theory

Module **Modulbezeichnung**	Selected Topics of Inelasticity Theory
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	STIT
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Markert, Bernd
Lecturer **Dozenten**	Markert, Bernd
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written or Oral Examination, Exercise, Lecture Schriftliche oder Mündliche Prüfung, Übung, Vorlesung
Workload **Arbeitsaufwand**	Total 150h, Contact hours 60h, Self-study 90 h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Selected Topics of Inelasticity Theory** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> The students understand the concepts of plasticity and viscoelasticity as important classes of inelastic material response with a wide range of engineering applications. They obtain a detailed understanding of selected aspects of the theories of plasticity and viscoelasticity, including specific algorithmic treatments. <u>Abilities / Skills:</u> The students understand the concepts of plasticity and viscoelasticity as important classes of inelastic material response with a wide range of engineering applications. They obtain a detailed understanding of selected aspects of the theories of plasticity and viscoelasticity, including specific algorithmic treatments.

Content **Inhalt**	**Selected Topics of Inelasticity Theory** 1. Introduction to inelastic material behavior 2. Kinematics of finite inelastic deformations in natural basis 3. Constitutive modeling with internal state variables 4. Derivation and evaluation of the dissipation inequality 5. Formulation of thermodynamical consistent inelastic evolution quations on the example of finite viscoelasticity and finite viscoplasticity 6. Local stress computation; numerical treatment of the evolution equations
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Selected Topics of Inelasticity Theory	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Selected Topics of Inelasticity Theory	MSPSE	0	75	30	45	
Exercise (Übung): Selected Topics of Inelasticity Theory	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Selected Topics of Inelasticity Theory
Studien-/Prüfungsleistung: Prüfung Selected Topics of Inelasticity Theory

Title **Titel**	Examination Selected Topics of Inelasticity Theory Prüfung Selected Topics of Inelasticity Theory
Sub-title **Untertitel**	P STIT
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Teaching Unit / Examinations: Lecture Selected Topics of Inelasticity Theory
Studien-/Prüfungsleistung: Vorlesung Selected Topics of Inelasticity Theory

Title **Titel**	Lecture Mechatronics of Forming Processes Vorlesung Mechatronics of Forming Processes
Sub-title **Untertitel**	V STIT
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Teaching Unit / Examinations: Exercise Selected Topics of Inelasticity Theory
Studien-/Prüfungsleistung: Übung Selected Topics of Inelasticity Theory

Title **Titel**	Exercise Selected Topics of Inelasticity Theory Übung Selected Topics of Inelasticity Theory
Sub-title **Untertitel**	Ü STIT

Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Module (Modul): Industrial Logistics

Module **Modulbezeichnung**	Industrial Logistics
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	IL
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Schuh, Günther Stich, Volker
Lecturer **Dozenten**	Schuh, Günther; Stich, Volker
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 150h, Contact hours 45, Self-study 105h Gesamt 150 h, Kontaktzeit 45 h, Selbststudium 105 h
Lecture hours **Kontaktzeit (SWS)**	3
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Industrial Logistics** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) know objectives and tasks of industrial logistics as well as main aspects of industrial logistics from organisational involvement to logistics controlling <u>Abilities / Skills:</u> *Students* a) understand the meaning and the effects of individual aspects of industrial logistics and can place them in the overall context <u>Competences:</u> *Students* a) are able to apply the acquired knowledge in Industrial Logistics to practical problems
Content	**Industrial Logistics**

Inhalt	• The lecture course "Industrial Logistics" covers a wide range of topics, which are relevant for the field of logistics. • It starts by appointing the logistics objectives and tasks. The following lectures cover the topics procurement, inventory management, product distribution and other related themes. Finally the lecture on Supply Chain Management is presented, whereby the new developments in the field of logistics research are of particular interest. • In addition, two guest lectures by external lecturers and an excursion complement the educational programme. <u>Content</u> • Introduction - Objectives and Tasks of Logistics • Procurement • Distribution • Inventory Management • Process- and Information Management • Material Flow Planning • Smart Objects • Supply Chain Management
Media **Medienform**	e-Learning L^{2}P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Industrial Logistics	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Industrial Logistics	MSPSE	0	90	30	60	
Exercise (Übung): Industrial Logistics	MSPSE	0	60	15	45	

Teaching Unit / Examinations: Examination Industrial Logistics
Studien-/Prüfungsleistung: Prüfung Industrial Logistics

Title **Titel**	Examination Industrial Logistics Prüfung Industrial Logistics
Sub-title **Untertitel**	IL
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Teaching Unit / Examinations: Lecture Industrial Logistics
Studien-/Prüfungsleistung: Vorlesung Industrial Logistics

Title **Titel**	Lecture Industrial Logistics Vorlesung Industrial Logistics
Sub-title **Untertitel**	V IL
Semester **Studiensemester**	2
Connection to the curriculum	Elective module Semestervariable Wahlleistung

Curriculare Verankerung	
Teaching Unit / Examinations: Exercise Industrial Logistics **Studien-/Prüfungsleistung: Übung Industrial Logistics**	
Title **Titel**	Examination Industrial Logistics Übung Industrial Logistics
Sub-title **Untertitel**	Ü IL
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Module (Modul): Multibody Dynamics

Module **Modulbezeichnung**	Multibody Dynamics
Modul level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MD
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Corves, Burkhard
Lecturer **Dozenten**	Corves, Burkhard
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 180h, Contact hours 60 h, Self-study 120 Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	6
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Multibody Dynamics** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) The students have a profound knowledge of theory of vibrations. b) The students are capable of comprehending, describing and analyzing vibratory systems. c) The students are familiar with the most important matrix based procedures for the calculation of eigen motions and the behaviour of linear systems under forced excitations. d) For the calculation of nonlinear system the students can select suitable program systems and carry out proper simulations. <u>Abilities / Skills:</u> a) The students have the ability of describing mathematically any mechanical system with its inherent physical effects like elasticity, damping and friction.

	b) The students are able to properly interpret simulation results especially under consideration of simplifications within the model compared to the real system. <u>Competencies:</u> a) The students are able to derive from their knowledge the necessary methods and proceedings for the analysis and synthesis of the systems in regard. Thus they are capable to solve - accessing their acquired theoretical knowledge - complex problems concerning the choice and design of industrial vibratory systems.
Content **Inhalt**	**Multibody Dynamics** • Introduction • Fundamentals • Fields of application • Model Building • Methods of Approach for Equivalent Models • Multi-body Systems • Determination of the Model Parameters • General mathematical description • Kinematics of Multi Body Systems • Position and Orientation of Bodies • Translational Kinematics • Rotational Kinematics • Equations of Motion • Lagrangian Equations of 2nd Kind • Newton-Euler equations • Linearisation • Eigen Value Approach • Undamped non-gyroscopic systems • Damped gyroscopic systems • Eigen Value Stability Criteria Linear Systems with Harmonic Excitation • Real Frequency Matrix • Complex Frequency Matrix • State Equation • System Matrix • Eigen Value Approach • Fundamental Matrix • Modal Matrix • Theorem of Cayley-Hamilton • Analytical Solution • Numerical Solution • Step Excitation • Harmonic Excitation • Periodical Excitation Introduction of Multi Body Simulation Software • ADAMS • SIMPACK • SimMechanics

	Hands-On-Laboratory for Multi Body Simulation Software • ADAMS • SIMPACK • SimMechanics Example • Modelling • Determination of Parameters • Calculation • Evaluation
Media **Medienform**	e-Learning L²P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Multibody Dynamics	MSPSE	6	0	0	0	120
Lecture (Vorlesung): Multibody Dynamics	MSPSE	0	90	30	60	
Exercise (Übung): Multibody Dynamics	MSPSE	0	90	30	60	

Teaching / Examinations: Examination Multibody Dynamics
Studien-/Prüfungsleistung: Prüfung Multibody Dynamics

Title **Titel**	Examination Multibody Dynamics Prüfung Multibody Dynamics
Sub-title **Untertitel**	MD
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Teaching / Examinations: Lecture Multibody Dynamics
Studien-/Prüfungsleistung: Vorlesung Multibody Dynamics

Title **Titel**	Lecture Multibody Dynamics Vorlesung Multibody Dynamics
Sub-title **Untertitel**	V MD
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Teaching / Examinations: Exercise Multibody Dynamics
Studien-/Prüfungsleistung: Übung Multibody Dynamics

Title **Titel**	Exercise Multibody Dynamics Übung Multibody Dynamics
Sub-title **Untertitel**	Ü MD
Semester	1

Studiensemester	
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlleistung

Module (Modul): Production Metrology

Module **Modulbezeichnung**	Production Metrology
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	ProMet
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Schmitt, Robert
Lecturer **Dozenten**	Schmitt, Robert
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	
Workload **Arbeitsaufwand**	Total 150, Contact hours 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	None
Learning Objectives **Angestrebte Lernergebnisse**	**Production Metrology** The aim of this lecture is to create the awareness, that “measuring” comprehends a lot more than plain data acquisition and metrology is a vital part of modern production processes. After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) know the function and the responsibility of metrology for production b) know the theoretical fundamentals which have to be taken into consideration while the measuring process is planned, controlled, analysed, are discussed c) know current measuring principles and devices in the field of industrial production d) know statistical fundamentals being necessary for analysis of the measured values <u>Abilities / Skills:</u> *Students* a) are able, to define measuring task on the basis of given features b) are able, to select adequate measuring devices for measuring tasks c) are able, to interpret measuring results

	Competencies: *Students* a) can make their decision (having arguments) for using metrology within production b) have learned to make decisions concerning measurement on the base of different parameters
Content **Inhalt**	**Production Metrology** Introduction • Relevance of metrology for quality assurance and its integration in production processes. Metrological Basics • Metrological concepts and definitions (Calibration, Uncertainty etc.) Tolerancing • Form and positional tolerances, tolerancing principles and basics Inspection Planning • Tasks and workflow of inspection planning, Procedure for creation of inspection plans Shop floor measuring devices/ Measuring sensors • Commonly used manual inspection devices for the shop floor, Function and application of inductive, capacitive and pneumatical sensors Optoelectronic inspection devices • Optical inspection systems for geometry testing and applications Form and surface inspection devices • Tactile and optical system for the characterisation of forms and surfaces, surfaces parameters Coordinate measurement technology • Principles, types and applications of coordinate measuring machines Gauging inspection • Form and positional gauging, Gauging Procedures Statistical basics • Statistical parameters for the description of production and • measuring processes, tests on normal distribution SPC, Process Capability • Statistical analysis and control of processes, Process capability indices Inspection device management • Tasks and procedures of inspection device management, Calculation of measuring device capability, Calibration chain
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam**

						Prüfungs-dauer (min)
Examination (Prüfung): Production Metrology	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Production Metrology	MSPSE	0	75	30	45	
Exercise (Übung): Production Metrology	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Production Metrology **Studien-/Prüfungsleistung: Prüfung Production Metrology**	
Title **Titel**	Examination Production Metrology Prüfung Production Metrology
Sub-title **Untertitel**	ProMet
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung
Teaching Unit / Examinations: Lecture Production Metrology **Studien-/Prüfungsleistung: Vorlesung Production Metrology**	
Title **Titel**	Lecture Production Metrology Vorlesung Production Metrology
Sub-title **Untertitel**	V ProMet
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung
Teaching Unit / Examinations: Exercise Production Metrology **Studien-/Prüfungsleistung: Übung Production Metrology**	
Title **Titel**	Exercise Production Metrology Übung Production Metrology
Sub-title **Untertitel**	Ü ProMet
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Factory Planning

Module **Modulbezeichnung**	Factory Planning
Modul level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	FP
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Achim Kampker
Lecturer **Dozenten**	Achim Kampker
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written Examination, Lecture, Exercise Klausur (Kl), Vorlesung (V)
Workload **Arbeitsaufwand**	Total 180, Contact hours 60h, Self-study 120h Gesamt 180 h, Kontaktzeit 60 h, Selbststudium 120 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	6
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Factory Planning** The lecture factory planning shows the state of the art of the particular topics. Best-practice methods and approaches are explained and reference solutions presented. After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) know and understand the main scope and challenges of factory planning projects. b) understand the basic principles and methods of the factory planning modules which are presented in the lectures goal definition & product/ process analysis, location planning & plant structure planning, industrial facility & building design, production structure planning & capacity planning, layout planning & workstation design, production logistics planning & production control, personnel planning & change management, implementation planning & ramp-up management and project management. <u>Abilities / Skills:</u>

	Students a) are able to apply the gained knowledge to assess different factory planning solutions in industrial practice. b) are able to develop own factory planning concepts of lower complexity within the presented modules. c) have the ability to solve factory planning problems independently. <u>Competences:</u> *Students* a) can participate in factory planning projects and collaborate with other planners. b) can cope with the high complexity in factory planning projects and are able to develop creative solutions.
Content **Inhalt**	**Factory Planning** L1/L2 - Introduction Comprehending the basic glossary, getting to know the content and understanding the challenges and requirements of modern factory planning and learn about the Aachen Factory Planning Methodology. L3/L4 - Definition of goals and Product and process analysis Getting to know methods for the definition of goals in early planning phases. Comprehending basic methods for the analysis of product and processes. L5/L6 – Location planning and plant structure planning The lecture focusses on the basic criteria for the selection of a specific plant location and methods for the planning of the particular plant structure. L7/8 – Industrial facility and Building design Getting to know the basic processes within industrial facility and building design and learning about different building concepts. L9/10 - Production structure planning and Capacity planning Introduction to production structure planning with an explanation of different concepts, understanding methods for the quantitative planning of production capacities and resources. L11/12 - Layout planning and Workstation design Introduction to challenges and targets of layout planning and acquiring knowledge of design and assessment of factory layouts. Getting to know basic targets and methods for the design of single workstations. L13/L14 - Production logistics planning and Production control Comprehend the basics of logistics planning, getting to know the development of logistic strategies and principles from sourcing to recycling processes and learning about basic principles in production control. L15/16 - Personnel planning and change management Introduction to personnel planning with its specific challenges and methods, learning about problems and solution approaches within change management processes. L17/18 - Implementation planning and ramp-up management Getting to know basic methods of implementation planning and understanding challenges within the ramp-up of new products. Learning about tools and methods within ramp-up management. L19/20 - Project management

	Understanding basic methods and principles within project management for the project planning and project execution & controlling.
Media **Medienform**	e-Learning L²P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Factory Planning	MSPSE	6	0	0	0	90
Lecture (Vorlesung): Factory Planning	MSPSE	0	90	30	60	
Exercise (Übung): Factory Planning	MSPSE	0	90	30	60	

Teaching / Examinations: Examination Factory Planning
Studien-/Prüfungsleistung: Prüfung Factory Planning

Title **Titel**	Examination Factory Planning Prüfung Factory Planning
Sub-title **Untertitel**	FP
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching / Examinations: Lecture Factory Planning
Studien-/Prüfungsleistung: Vorlesung Factory Planning

Title **Titel**	Lecture Factory Planning Vorlesung Factory Planning
Sub-title **Untertitel**	V FP
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching / Examinations: Examination Factory Planning
Studien-/Prüfungsleistung: Übung Factory Planning

Title **Titel**	Exercise Factory Planning Ubung Factory Planning
Sub-title **Untertitel**	U FP
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Modeling, Model Reduction and Simulation in Laser Processing - Lasers

Module **Modulbezeichnung**	Modeling, Model Reduction and Simulation in Laser Processing - Lasers
Modul level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MMRSLP L
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Schulz, Wolfgang
Lecturer **Dozenten**	Schulz, Wolfgang
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 150h, Contact hours 60h, Self-study 90h Gesamt 150h, Kontaktzeit 60h, Selbststudium 90h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Modelling, Model Reduction and Simulation in Laser Processing - Lasers** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) experimental evidence of Maxwell equations b) refraction, diffraction and scattering, Fresnel- number N_f, and applications c) can perform the derivation of SVE-approximation d) Laser light, can perform the calculation imaging and focussing e) know at least 3 types of laser systems, temporal and spatial distribution of laser radiation, Fresnel-number, invariant quantity of light propagation f) understand the structure of solution for the Helmholtz-equation, diffraction, 5 parameter pairs of optical material equations, transmission, reflection, absorption, Fresnel Formulae, polarisation of matter and radiation g) know the main properties of the solution in the asymptotic case of paraxial light propagation and can explain the relation between optical and material parameters

	h) know the effect of coupling between atoms and can explain the relation between band structure and optical properties i) understand the interactive cooperation of scientists from engineering, physics and mathematics for application of model based methods for diagnosis in laser processing <u>Abilities / Skills:</u> j) Application of model based methods for solving practical tasks of laser design from discussion of project examples
Content **Inhalt**	**Modelling, Model Reduction and Simulation in Laser Processing - Lasers** Overview of contents, definition of the 10 learning targets • the contribution of the engineer to the interactive cooperation of scientific disciplines • main features of the theory of cognition (Karl Popper) • Light: amplitude and phase, Fermat's principle, laser radiation, Helmholtz equation, diffraction, Fresnel- number N_f, reduced model: SVE-approximation • Learning target 1: experimental origin of Maxwell equations, Rayleigh scattering, Laser Principle • Learning target 2: ABCD-matrix, ABCD-law • Learning target 3: beam parameter product, optical invariant • Matter: emission spectra, band structure, reflection, transmission and absorption of light, • Learning target 4: isolator, semiconductor, metal, gas • Learning target 5: Rydberg constant, Planck's law • Learning target 6: reduced model of the Fresnel Formulae for the limiting case of small displacement current, optical parameters • Gaussian Beam: beam quality, beam guiding and forming • Learning target 7: quality features of light, Plane-, spherical- and Gouy-phase Quality number K and focussing F-number • Resonator: frequency filter, axial mode structure • Learning target 8: feedback-axial mode structure, g-parameter, aperture-lateral mode, Fresnel number N_f, rod and tube design • Active Medium: entropy, phase transition of 2. Kind, Einstein rate equations • Learning target 9: Gas and Solid-state and Diode Laser • Learning target 10: laser threshold, cooling, pumping • Modulation: Gain switch µs, Q-Switch ns, Mode locking fs • Learning target 11: phase coupling • concluding discussion of the learning targets • actual research and development of laser processing
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Modeling, Model Reduction	MSPSE	5	0	0	0	120

and Simulation in Laser Processing - Lasers						
Lecture (Vorlesung): Modeling, Model Reduction and Simulation in Laser Processing - Lasers	MSPSE	0	75	30	45	
Exercise (Übung): Modeling, Model Reduction and Simulation in Laser Processing - Lasers	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Modeling, Model Reduction and Simulation in Laser Processing - Lasers **Studien-/Prüfungsleistung: Prüfung Modeling, Model Reduction and Simulation in Laser Processing - Lasers**	
Title **Titel**	Examination Modeling, Model Reduction and Simulation in Laser Processing - Lasers Prüfung Modeling, Model Reduction and Simulation in Laser Processing - Lasers
Sub-title **Untertitel**	MMRSLP L
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung
Teaching Unit / Examinations: Lecture Modeling, Model Reduction and Simulation in Laser Processing - Lasers **Studien-/Prüfungsleistung: Vorlesung Modeling, Model Reduction and Simulation in Laser Processing - Lasers**	
Title **Titel**	Lecture Modeling, Model Reduction and Simulation in Laser Processing - Lasers Vorlesung Modeling, Model Reduction and Simulation in Laser Processing - Lasers
Sub-title **Untertitel**	V MMRSLP L
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung
Teaching Unit / Examinations: Exercise Modeling, Model Reduction and Simulation in Laser Processing - Lasers **Studien-/Prüfungsleistung: Übung Modeling, Model Reduction and Simulation in Laser Processing - Lasers**	
Title **Titel**	Exercise Modeling, Model Reduction and Simulation in Laser Processing - Lasers Übung Modeling, Model Reduction and Simulation in Laser Processing - Lasers
Sub-title **Untertitel**	Ü MMRSLP L
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Modelling, Model Reduction and Simulation in Laser Processing - Applications

Module **Modulbezeichnung**	Modeling, Model Reduction and Simulation in Laser Processing - Applications
Modul level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MMRSLP A
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Schulz, Wolfgang
Lecturer **Dozenten**	Schulz, Wolfgang
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 150h, Contact hours 60h, Self-study 90h Gesamt 150h, Kontaktzeit 60h, Selbststudium 90h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Modelling, Model Reduction and Simulation in Laser Processing - Applications** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) Free Boundary Problems and integral methods of solution, b) non-linear stability analysis using spectral methods, c) analysis of the structural stability of model equations and d) 5 parameter pairs of optical material equations, transmission, reflection, absorption, Fresnel Formulae, polarisation of matter and radiation Learning target 2: optical parameters e) Slow surfaces in dynamical Systems: applications for separation of time scales Learning target 6: Thermal effect of large and small Peclet-number,

	f) know and understand the 5 different, dominant phenomena of drilling, welding and cutting with laser radiation Learning target 5: quality features g) know the physical meaning of the terms contained in the Navier-Stokes equations for mass, momentum, and energy balance h) know the main properties of the solution in the asymptotic case of thin film flow (boundary layer) and can explain the relation between dynamical properties of the solution and quality features of the product as well as productivity of the process for drilling and cutting i) know the effect of dissipation in distributed dynamical systems (inertial manifold) and know examples for the application of methods for the reduction of the dimension in dissipative systems, understand and perform the separation of length and time scales in simple systems Learning target 7: heating and melting phase of ablation j) understand the interactive cooperation of scientists from engineering, physics and mathematics for application of model based methods for diagnosis in laser processing Learning target 8: reduced modelling <u>Abilities / Skills:</u> a) Application of model based methods for solving practical tasks from discussion of project examples
Content **Inhalt**	**Modelling, Model Reduction and Simulation in Laser Processing - Applications** Overview of contents, definition of the 10 learning targets • the contribution of the engineer to the interactive cooperation of scientific disciplines • main features of the theory of cognition (Karl Popper) • recapitulation of the 10 learning targets from Module I: Laser • Learning target 1: at least 10 industrial applications of laser radiation • Learning target 2: reduced model of the Fresnel Formulae for the limiting case of small displacement current, optical parameters • technical task and examples: cutting with laser radiation • Learning target 3: quality features of the high quality cut • physical task of cutting and identification of quality defined processing domains • Learning target 4: relation of physical phenomena to the built up of quality degradations • technical task and examples: drilling with laser radiation • physical task formulation and 5 dominant phenomena • Learning target 5: quality features of the drilled hole • mathematical modelling Ia: length and time scales • degrees of freedom in phase space of dependent variables • separation of time scales in simple dynamical systems • Learning target 6a: separation of time scales • mathematical modelling Ib: singular perturbation and asymptotic expansion • thermal boundary layer in heat conduction with moving boundaries • Learning target 6b: separation of length scales • mathematical modelling II: Free Boundary Problems (FBP) for the solid phase • reduced model for the FBP : motion of the melting front, integral methods, variational formulation • Learning target 7: heating and melting phase of ablation • mathematical modelling III: Meta-Modelling Morse-Smale-Complex • Learning target 8: reduced model of drilling and cutting • mathematical model reduction: melt flow • reduced model for thin film flow • Learning target 9: ripple and dross formation in cutting

	• model reduction and solution with controlled error: melt flow at low Reynolds-number • structural stability of the reduced model: lubrication approximation, fingering and droplet formation • global properties of the solution of balance equations for mass, momentum and thermal energy – example: cutting • Learning target 10: scales for parameter estimation in laser processing parameters in cutting and drilling • concluding discussion of the learning targets • actual research and development of laser processing
Media **Medienform**	e-Learning L^2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Modeling, Model Reduction and Simulation in Laser Processing - Applications	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Modeling, Model Reduction and Simulation in Laser Processing - Applications	MSPSE	0	75	30	45	
Exercise (Übung): Modeling, Model Reduction and Simulation in Laser Processing - Applications	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Modeling, Model Reduction and Simulation in Laser Processing - Applications
Studien-/Prüfungsleistung: Prüfung Modeling, Model Reduction and Simulation in Laser Processing - Applications

Title **Titel**	Examination Modeling, Model Reduction and Simulation in Laser Processing - Applications Prüfung Modeling, Model Reduction and Simulation in Laser Processing - Applications
Sub-title **Untertitel**	MMRSLP A
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching Unit / Examinations: Lecture Modeling, Model Reduction and Simulation in Laser Processing - Applications
Studien-/Prüfungsleistung: Vorlesung Modeling, Model Reduction and Simulation in Laser Processing - Applications

Title **Titel**	Lecture Modeling, Model Reduction and Simulation in Laser Processing - Applications Vorlesung Modeling, Model Reduction and Simulation in Laser Processing - Applications
Sub-title **Untertitel**	V MMRSLP A
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching Unit / Examinations: Exercise Modeling, Model Reduction and Simulation in Laser Processing - Applications **Studien-/Prüfungsleistung: Übung Modeling, Model Reduction and Simulation in Laser Processing - Applications**	
Title **Titel**	Exercise Modeling, Model Reduction and Simulation in Laser Processing - Applications Übung Modeling, Model Reduction and Simulation in Laser Processing - Applications
Sub-title **Untertitel**	Ü MMRSLP A
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Modelling, Model Reduction and Simulation in Laser Processing - Design

Module **Modulbezeichnung**	Modeling, Model Reduction and Simulation in Laser Processing – Design
Modul level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MMRSLP D
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	2
Person in Charge **Modulverantwortliche**	Schulz, Wolfgang
Lecturer **Dozenten**	Schulz, Wolfgang
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 150h, Contact hours 60h, Self-study 90h Gesamt 150h, Kontaktzeit 60h, Selbststudium 90h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Modelling, Model Reduction and Simulation in Laser Processing - Design** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) Design of Research is based on formulation of a research question followed by research hypothesis, state of the art, contributions of theory and experiment; b) Design Thinking for laser specification and laser processes by formulating specific research hypothesis leading to Reduced Models using the methods: 1. Dimensional Analysis, 2. Dimensionless groups, 3. Inertial Manifolds and Central Manifolds, 4. Length scale analysis and time scale separation; c) know how to adapt laser properties to high performance processing;

	d) understand the interactive cooperation of scientists from engineering, physics and mathematics for application of model based methods for diagnosis in laser processing. Abilities / Skills: e) apply model based methods for solving practical tasks of laser design.
Content **Inhalt**	**Modelling, Model Reduction and Simulation in Laser Processing - Design** Overview of contents, definition of the 4 methodological (M1-M4) and 5 laser specific (L1-L5) learning targets: Learning target M1 - Cooperation Engineering: the contribution of the engineer to the interactive cooperation of scientific disciplines (“Flowchart” approach) Learning target M2 - Meta-Modelling: main features of the theories for “design thinking” by “meta-modelling” are model reduction methods MRM: mathematical, empirical and numerical approaches global approximation and optimization methods sensitivity analysis and hierarchical models Learning target M3 - model reduction methods MRM: Buckingham’s Pi-Theorem(mathematical MRM) Model hierarchy threshold (empirical MRM)) Kriging global approximation versus response surface (numerical MRM) Proper orthogonal decomposition POD(numerical MRM) Learning target M4 - mathematical MRM: Analysis of dissipative distributed systems applied to standard examples Time scale separation (Inertial manifolds) Singular perturbation Learning target L1 – heating and melting phenomena Laser Polishing (Marangoni effect, evaporation) Learning target L2 - evaporation phenomena Laser induced thermal stress analysis Laser driven EUV-Sources (Extreme Ultra-Violet EUV) Laser Propulsion - Light Engine Learning target L3 - linear excitation phenomena Laser Induced Fluorescence (LIF): biological carrier for TNT detection Learning target L4 - nonlinear Multi-Photon phenomena Laser Fila mentation – Kerr effect, Multi-photon absorption Multi-Photon Lithography Learning target L5 - Coherence phenomena Optical Coherence Tomography (OCT) Particle detection (PIV, LDV, DGV, FRS) Laser Interferometer Space Antenna (LISA) Laser Time Measurement - Frequency Comb Physical Limits related to energy manipulation (Laser Fusion, Laser Cooling)

	Concluding discussion of the learning targets and • Actual research and development of laser processing
Media **Medienform**	e-Learning L²P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Modeling, Model Reduction and Simulation in Laser Processing – Design	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Modeling, Model Reduction and Simulation in Laser Processing - Design	MSPSE	0	75	30	45	
Exercise (Übung): Modeling, Model Reduction and Simulation in Laser Processing - Design	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Modeling, Model Reduction and Simulation in Laser Processing - Design
Studien-/Prüfungsleistung: Prüfung Modeling, Model Reduction and Simulation in Laser Processing - Design

Title **Titel**	Examination Modeling, Model Reduction and Simulation in Laser Processing - Design Prüfung Modeling, Model Reduction and Simulation in Laser Processing - Design
Sub-title **Untertitel**	MMRSLP D
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching Unit / Examinations: Lecture Modeling, Model Reduction and Simulation in Laser Processing - Applications
Studien-/Prüfungsleistung: Vorlesung Modeling, Model Reduction and Simulation in Laser Processing - Applications

Title **Titel**	Lecture Modeling, Model Reduction and Simulation in Laser Processing - Applications Vorlesung Modeling, Model Reduction and Simulation in Laser Processing - Applications
Sub-title **Untertitel**	V MMRSLP D
Semester **Studiensemester**	2
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching Unit / Examinations: Exercise Modeling, Model Reduction and Simulation in Laser Processing - Design
Studien-/Prüfungsleistung: Übung Modeling, Model Reduction and Simulation in Laser Processing - Design

Title **Titel**	Exercise Modeling, Model Reduction and Simulation in Laser Processing - Design Übung Modeling, Model Reduction and Simulation in Laser Processing - Design
Sub-title **Untertitel**	Ü MMRSLP D
Semester **Studiensemester**	2

Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Advanced Software Engineering

Module **Modulbezeichnung**	Advanced Software Engineering
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	ASE
Lecture **Lehrveranstaltungen**	Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Meisen, Tobias
Lecturer **Dozenten**	Meisen, Tobias
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 150h, Contact hour 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Advanced Software Engineering** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> a) They comprehend for what purposes, under which conditions and with which consequences computer systems are used for the solution of problems related to Mechanical Engineering. b) They gain a solid knowledge in the Software Development Life Cycle and the main activities and core concepts under each software development phase. <u>Abilities / Skills:</u> a) They have the ability to transfer the acquired knowledge in object oriented design to different engineering problems and understand the general structure and the functionality of software.
Content **Inhalt**	**Advanced Software Engineering**

	The aim of the course is to explain students for what purposes, under which conditions and with which consequences computer systems are used for the solution of problems related to Mechanical Engineering. Within the first part of the course the steps from problem description to the final software solution are illustrated. This covers the topics modelling, problem elicitation and analysis, program design and an introduction to UML (Unified Modelling Language). Then the course goes on with a closer examination of the various aspects which comprise software development, concerning with topics like design patterns, agile software processes and project management. Parallel to the lecture the students are given the chance to employ the theoretical input from the course in small software projects. After an introduction to the basics of Java and object-oriented programming, the students stepwise pass through the particular stages of a software development process. Moreover, a part of the exercise is implemented by using physical robots.
Media **Medienform**	e-Learning L2P, Power Point
Literature **Literatur**	Recommended: • Basic knowledge in a programming language (e.g. C, C++)

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Advanced Software Engineering	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Advanced Software Engineering	MSPSE	0	75	30	45	
Exercise (Übung): Advanced Software Engineering	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Advanced Software Engineering
Studien-/Prüfungsleistung: Prüfung Advanced Software Engineering

Title **Titel**	Examination Software Engineering Prüfung Advanced Software Engineering
Sub-title **Untertitel**	ASE
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching Unit / Examinations: Lecture Advanced Software Engineering
Studien-/Prüfungsleistung: Vorlesung Advanced Software Engineering

Title **Titel**	Lecture Software Engineering Vorlesung Advanced Software Engineering
Sub-title **Untertitel**	V ASE
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching Unit / Examinations: Exercise Advanced Software Engineering
Studien-/Prüfungsleistung: Übung Advanced Software Engineering

Title **Titel**	Exercise Software Engineering Übung Advanced Software Engineering

Sub-title **Untertitel**	Ü ASE
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Tribology

Module **Modulbezeichnung**	Tribology
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	TB
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Jacobs, Georg
Lecturer **Dozenten**	Jacobs, Georg
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 150h, Contact hour 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	-none-
Learning Objectives **Angestrebte Lernergebnisse**	**Tribology** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> *Students* a) know fundamental mechanisms in the contact zone of tribosystems: - hydrodynamics - material deformation - tribological stress - fluid / solid body friction - wear <u>Abilities / Skills:</u> *Students* a) are able to employ the fundamental theories to design and analyze tribosystems. b) are able to design tribosystems in mechanical systems, like journal bearings, roller bearings, gear wheels and seals. <u>Competences:</u>

	Students a) are theoretically capable of choosing and applying different suitable measuring- and test systems to investigate the tribosystems of journal bearings, roller bearings, gear wheels and seals. b) are capable of choosing and applying different suitable calculation and simulation methods to investigate the tribosystems of journal bearings, roller bearings, gear wheels and seals. c) are capable of estimating the quality of the tribosystem according to the test and simulation results and to optimize it with the background knowledge of a considerably large action catalogue. d) are able to design the tribosystems of the mechanical components of drive trains. e) are able to minimize friction and wear in mechanical drive trains. In that way, they can enhance the resource and energy efficiency of drive train systems.
Content **Inhalt**	**Tribology** Basics of tribology: • Tribosystem in general and its analysis • Wear and friction processes • Test methods Interactions between base and contact bodies: • Contact processes and geometries, material strain, Hertzian theory, contact mechanics • Frictional processes and the results and influence on the tribosystem, wear processes and methods to avoid wear and losses Properties of base and contact bodies: • Tribomaterials and the analysis of technical surfaces, roughness, hardness definitions and test methods • Coating types and methods and their technical application, systematical methods and examples for the correct choice of material Properties of intermediate medium: • Basic properties, dependencies and test methods for the viscosity • Classification, properties and application examples for different lubricants (oils, greases and solid lubricants) Basics of hydrodynamics and elastohydrodynamics: • Fundamentals and principles of flow mechanisms, derivation of Navier-Stokes and Reynolds equations and continuity equation • Application of the hydrodynamic equations regarding the calculation of bearings • Basics of the elastohydrodynamics Tribosystem journal bearings: • Functionality and calculation of hydrodynamic axial and radial journal bearings • Damages and failures of hydrodynamic journal bearings • Choice of suitable lubricants for hydrodynamic journal bearings • Functionality and calculation of hydrostatic axial and radial journal bearings • Damages and failures of hydrostatic journal bearings • Choice of suitable lubricants for hydrostatic journal bearings Tribosystem gear wheels: • Lubricants and materials for gears and their influence and application • Application of the EHD-theory for gear stages • Damages and failures of gear wheels and suitable test methods for the analysis of gear stages Tribosystem roller bearings: • Design, materials and lubrication for roller bearings • Friction, damages and failures for roller bearings • Test methods for the analysis of roller bearings Tribosystem seals: • Different types and designs of seals

	• Specialties and application of different seals • Materials for seals
Media **Medienform**	e-Learning L2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Tribology	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Tribology	MSPSE	0	75	30	45	
Exercise (Übung): Tribology	MSPSE	0	75	30	45	

Teaching Unit / Examinations: Examination Tribology
Studien-/Prüfungsleistung: Prüfung Tribology

Title **Titel**	Examination Tribology Prüfung Tribology
Sub-title **Untertitel**	TB
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching Unit / Examinations: Lecture Tribology
Studien-/Prüfungsleistung: Vorlesung Tribology

Title **Titel**	Lecture Tribology Vorlesung Tribology
Sub-title **Untertitel**	V TB
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Teaching Unit / Examinations: Exercise Tribology
Studien-/Prüfungsleistung: Übung Tribology

Title **Titel**	Exercise Tribology Übung Tribology
Sub-title **Untertitel**	Ü TB
Semester **Studiensemester**	1
Connection to the curriculum **Curriculare Verankerung**	Elective module Semestervariable Wahlpflichtleistung

Module (Modul): Machine Design Process

Module **Modulbezeichnung**	Machine Design Process
Modul Level **Modulniveau**	Master
Code **Kürzel**	MSPSE
Subtitle **Untertitel**	MDP
Lecture **Lehrveranstaltungen**	See list of lectures and examinations of the module Siehe Liste der Prüfungsleistungen des Moduls
Semester **Studiensemester**	1
Person in Charge **Modulverantwortliche**	Feldhusen, Jörg
Lecturer **Dozenten**	Feldhusen, Jörg
Language **Sprache**	English Englisch
Assignment to the curriculum **Zuordnung zum Curriculum**	Elective module Semestervariable Wahlpflichtleistung
Teaching form **Lehrformen**	Written examination, Lecture, Exercise Klausur (Kl), Vorlesung (V), Übung (Ü)
Workload **Arbeitsaufwand**	Total 150h, Contact hour 60h, Self-study 90h Gesamt 150 h, Kontaktzeit 60 h, Selbststudium 90 h
Lecture hours **Kontaktzeit (SWS)**	4
ECTS-Credit Points (CP) **Kreditpunkte**	5
Requierments according to examination regulation **Voraussetzungen nach Prüfungsordnungen**	None
Learning Objectives **Angestrebte Lernergebnisse**	**Machine Design Process and Practical Applications of Computer- Aided Engineering Tools** After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> Students a) know the most common machine elements and applicable design rules, standards and understand production drawings including dimensions and tolerances. b) know structured problem solving strategies, esp. the engineering design process acc. to VDI 2221. c) know the structure and some examples of the body of design rules <u>Competencies</u>: Students d) are able to analyse and design mechanical systems using common machine elements through the ability to read and understand as well as draft assembly

	drawings according to ISO drawing standards and define the production specifications on machined parts through the ability of drafting production drawings according to ISO drawing standards. e) are able to identify possible restrictions on a design task and to develop and select applicable concept solutions with a systematic approach. f) are able to assess the applicability of design rules depending on effective design restrictions. Basic rules of embodiment design, design principles and guidelines are applied to draw up technical drafts.
Content **Inhalt**	**Machine Design Process** Topic: Introduction Topic: Drawing Standards I • Projection drawing and axonometric views • Elements of technical drawings • Dimensioning Topic: Drawing Standards II • Section views • Broken views Topic: Joins and Connections • Connection types • Bolted connections • Shaft and hub connections Topic: Geometrical Irregularities and Tolerances • Dimension tolerances • Form and position tolerances • Technical surfaces Topic: Bearing of Shafts • Bearing principles • Bearing arrangements • Seals Topic: Power Transmission • Definitions and principles • Technical representation • Examples Topic: Engineering Design Process, Requirements List • Introduction to design methodology • General process of engineering design • Requirements list Topic: Conceptual Design I • Function structures and principle solutions • Design catalogues • Heuristic and analogy methods Topic: Conceptual Design II • Systematic variation, classification schemes • Overall solutions: morphological matrix Topic: Design Rules I - Basic Rules • Introduction to design rules • Basic rules ´simple´ and ´clear´ • Basic rule ´safe´

	Topic: Design Rules II - Principles • Principles of fault-free design, force transmission, stability and bi-stability, self-help, division of tasks Topic: Design Rules III – Guidelines / DFX • Selected examples: design for assembly and production...
Media **Medienform**	e-Learning L2P, Power Point
Literature **Literatur**	

Lectures / Examinations
Studien-/Prüfungsleistungen

Title **Titel**	**Code** **Kürzel**	**ECTS** **Kredit-punkte**	**Workload** **Arbeits-aufwand (h)**	**Lecture H.** **Kontakt-zeit (h)**	**Self-study** **Selbst-studium (h)**	**Duration of Exam** **Prüfungs-dauer (min)**
Examination (Prüfung): Machine Design Process	MSPSE	5	0	0	0	120
Lecture (Vorlesung): Machine Design Process	MSPSE	0	75	60	45	
Exercise (Übung): Machine Design Process	MSPSE	0	75	60	45	

Teaching Unit / Examinations: Examination Machine Design Process **Studien-/Prüfungsleistung: Prüfung Machine Design Process**	
Titel	Examination Machine Design Process Prüfung Machine Design Process
Untertitel	MDP
Studiensemester	1
Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung
Teaching Unit / Examinations: Lecture Machine Design Process **Studien-/Prüfungsleistung: Vorlesung Machine Design Process**	
Titel	Lecture Machine Design Process Vorlesung Machine Design Process
Untertitel	V MDP
Studiensemester	1
Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung
Teaching Unit / Examinations: Exercise Machine Design Process **Studien-/Prüfungsleistung: Übung Machine Design Process**	
Titel	Exercise Machine Design Process Übung Machine Design Process
Untertitel	Ü MDP
Studiensemester	1
Curriculare Verankerung	Elective module Semestervariable Wahlpflichtleistung