

**Module: Surface Engineering and Tribology**

<b>Level</b>	Master	<b>Short Name</b>	SETri
<b>Responsible Lecturers</b>	Prof. Dr. rer. nat. Arne Bender		
<b>Department, Facility</b>	Mechanical Engineering and Business Administration		
<b>Course of Studies</b>	Mechanical Engineering, Master		
<b>Compulsory/elective</b>	Elective	<b>ECTS Credit Points</b>	5
<b>Semester of Studies</b>	2	<b>Semester Hours per Week</b>	4
<b>Length (semesters)</b>	1	<b>Workload (hours)</b>	150
<b>Frequency</b>	WiSe	<b>Presence Hours</b>	60
<b>Teaching Language</b>	English	<b>Self-Study Hours</b>	90

The following section is filled only if there is **exactly one** module-concluding exam.

<b>Exam Type</b>	Written Exam	<b>Exam Language</b>	English
<b>Exam Length (minutes)</b>	120	<b>Exam Grading System</b>	One-third Grades

<b>Learning Outcomes</b>	<p>In many applications, the performance of a mechanical component is rather controlled by the surface properties than by the bulk (volume) material properties. Catalysis, corrosion, adhesion or non-adhesion, friction and wear, optical effects, biological processes (implants) are examples for such applications. Precise control of the surface properties is necessary to get optimal system performance and longevity. This lecture will discuss several surface related applications; different surface engineering approaches to problems will be discussed and compared. According test and analysis methods will be introduced and applied.</p> <p>Tribology is the science of friction, wear and lubrication. Friction and wear appear in every situation where a fluid or a rigid body slides against a surface. Control of friction and wear is essential for proper system function, high energy efficiency, and a long component life. This lecture introduces into the basic concepts of tribology and tribological testing. Special emphasis is put on the analysis of practical tribological problems and a systematic approach to their solution.</p> <p>The student will have a theoretical understanding of the physical and chemical surface properties of materials,</p> <p>The student will be able to analyse the requirements for several practical applications and to select suitable surface treatments or coatings,</p> <p>The student will be enabled to perform a system analysis of tribo-systems,</p> <p>The student will be able to describe different friction modes, wear mechanisms and to optimise the tribological system performance.</p>
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<b>Participation Prerequisites</b>	Material science lecture from the bachelor programme, material science from the master programme Recommended: Knowledge in heat treatment of metals
The previous section is filled only if there is <b>exactly one</b> module-concluding exam.	
<b>Consideration of Gender and Diversity Issues</b>	<ul style="list-style-type: none"> <li>✓ Use of gender-neutral language (THL standard)</li> <li>✓ Target group specific adjustment of didactic methods</li> <li>✗ Making subject diversity visible (female researchers, cultures etc.)</li> </ul>
<b>Applicability</b>	MSc thesis
<b>Remarks</b>	

## Module Course: Surface Engineering and Tribology

(of Module: Surface Engineering and Tribology)

<b>Course Type</b>	Lecture	<b>Form of Learning</b>	Presence
<b>Mandatory Attendance</b>	no	<b>ECTS Credit Points</b>	4
<b>Participation Limit</b>		<b>Semester Hours per Week</b>	3
<b>Group Size</b>		<b>Workload (hours)</b>	120
<b>Teaching Language</b>	English	<b>Presence Hours</b>	45
<b>Study Achievements ("Studienleistung", SL)</b>		<b>Self-Study Hours</b>	75
<b>SL Length (minutes)</b>		<b>SL Grading System</b>	

The following section is filled only if there is a course-specific exam.

<b>Exam Type</b>		<b>Exam Language</b>	
<b>Exam Length (minutes)</b>		<b>Exam Grading System</b>	
<b>Learning Outcomes</b>			
<b>Participation Prerequisites</b>			

The previous section is filled only if there is a course-specific exam.

<b>Contents</b>	<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>• typical materials and their surface properties</li> <li>• surface structure and structure of coatings</li> <li>• overview of several coating techniques and surface treatments</li> <li>• polymer surfaces and polymer coatings</li> </ul> <p><b>Testing and analysis in surface engineering</b></p> <ul style="list-style-type: none"> <li>• optical effects, adhesion or non adhesion, longevity, tribology</li> <li>• roughness, hardness, contact angle (surface energy), light microscopy, SEM, EDX</li> </ul> <p><b>Tribology</b></p> <ul style="list-style-type: none"> <li>• tribological-system</li> <li>• sliding modes</li> <li>• micro-mechanisms of friction and wear</li> <li>• lubrication and lubricants</li> <li>• friction and wear testing, characteristic values</li> <li>• system analysis of tribo-systems</li> </ul> <p><b>Surfaces in several industrial applications</b></p> <ul style="list-style-type: none"> <li>• medicine, food, transport, chemistry</li> <li>• standards and approval</li> <li>• damages, problems and solutions</li> </ul> <p><b>Laboratory</b></p> <ul style="list-style-type: none"> <li>• pre-treatment and coating of materials</li> <li>• characterisation of treatment result</li> </ul>
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	<ul style="list-style-type: none"><li>• material test with a tribometer</li></ul>
<b>Literature</b>	<ul style="list-style-type: none"><li>• Script Theoretical Surface Science</li><li>• Theo Mang, Kirsten Bobzin and Thorsten Bartels, Industrial Tribology</li><li>• Michel Cartier, Handbook of Surface Treatments and Coatings</li><li>• A current list will be distributed at the beginning of the lecture.</li></ul>
<b>Remarks</b>	

## Module Course: Surface Engineering and Tribology (Laboratory)

(of Module: Surface Engineering and Tribology)

<b>Course Type</b>	Practical Training	<b>Form of Learning</b>	Presence
<b>Mandatory Attendance</b>	yes	<b>ECTS Credit Points</b>	1
<b>Participation Limit</b>		<b>Semester Hours per Week</b>	1
<b>Group Size</b>	7	<b>Workload (hours)</b>	30
<b>Teaching Language</b>		<b>Presence Hours</b>	15
<b>Study Achievements ("Studienleistung", SL)</b>	Practical Training	<b>Self-Study Hours</b>	15
<b>SL Length (minutes)</b>		<b>SL Grading System</b>	Pass

The following section is filled only if there is a course-specific exam.

<b>Exam Type</b>		<b>Exam Language</b>	
<b>Exam Length (minutes)</b>		<b>Exam Grading System</b>	
<b>Learning Outcomes</b>			
<b>Participation Prerequisites</b>			

The previous section is filled only if there is a course-specific exam.

<b>Contents</b>	Laboratory <ul style="list-style-type: none"> <li>• pre-treatment and coating of materials</li> <li>• characterisation of treatment result</li> <li>• material test with a tribometer</li> </ul>
<b>Literature</b>	Descriptions of laboratory exercises
<b>Remarks</b>	