


Studiengang: <b>Master of Science Maschinenbau</b> Program: <i>Master of Science in Mechanical Engineering</i>															
1	Module: <b>Polymer Science</b> Modul: <i>Kunststoffkunde</i>				<b>English</b> <i>Englisch</i>										
	<b>Fach-Nr.</b> <i>Course number</i>	<b>Semester</b> <i>Semester</i>	<b>Dauer</b> <i>Duration</i>	<b>Status</b> <i>Status</i>	<b>Turnus</b> <i>Regular cycle</i>										
		2. Semester	1 Semester	compulsory elective	annual										
	<b>Kreditpunkte</b> <i>Credits</i>	<b>Aufwand</b> <i>Workload</i>	<b>Kontaktzeit</b> <i>Contact-hours</i>	<b>Selbststudium</b> <i>Student's efforts</i>											
	5 ECTS	150hrs	4 hrs/week = 60 hrs lecture	30hrs exam preparation 30hrs cont. preparation and exercises 30hrs Self-study											
2	<b>Beschreibung</b> <i>Description</i> Polymeric materials are increasingly used as structural materials in engineering design. Polymers, however, have a completely different behaviour than metals. These peculiarities of the polymeric materials have to be carefully considered during the design process in order to fully utilise the benefits of polymers and to compensate the shortcomings. This lecture will introduce into the chemistry, physics and mechanics of polymers on a scientific level. Recent developments in the fields of polymeric materials and polymer processing will be discussed.														
3	<b>Lernziele</b> <i>Learning Outcomes</i> The students will be able to <ul style="list-style-type: none"> <li>describe the different types of polymerisation reactions and to assign typical plastics to the according polymerisation types,</li> <li>distinguish thermoplastics, thermosets, elastomers, LCPs and TPEs with respect of structure, processing and usage properties and to select among these material families for practical applications,</li> <li>describe the most common representatives of the aforementioned polymer families with respect to structure, processing and usage properties and to specify typical advantages and shortcomings,</li> <li>name typical additives for polymers, explain their effect on the material properties, and describe the most common compounding methods,</li> <li>describe qualitatively and mathematically the mechanical (non-linear elasticity, creep, visco-elasticity), physical (dielectricity, interaction with radiation), thermal (transitions, solidification and melting), thermo-mechanical (DMTA, residual stresses from processing), and chemical (oxidation, soaking) peculiarities of polymeric materials,</li> <li>describe and explain typical testing procedures for polymers,</li> <li>describe and explain processing effects on the performance of polymers and plastic products,</li> <li>describe the most common processing methods (injection moulding, extrusion, thermoforming) and common derivatives of them.</li> </ul>														
4	<b>Schlüsselqualifikationen</b> <i>Key qualifications</i> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:20%;">Sozialkompetenz</td> <td style="width:20%;">Methodenkompetenz</td> <td style="width:20%;">Selbstkompetenz / Personenkompetenz</td> <td style="width:20%;">Interkulturelle Kompetenz</td> <td style="width:20%;">Medienkompetenz</td> </tr> <tr> <td></td> <td style="text-align:center;">X</td> <td style="text-align:center;">X</td> <td></td> <td></td> </tr> </table>					Sozialkompetenz	Methodenkompetenz	Selbstkompetenz / Personenkompetenz	Interkulturelle Kompetenz	Medienkompetenz		X	X		
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5	<b>Lehrveranstaltung/ -methoden</b> <i>Course type and methods</i> <b>Lecture</b> <ul style="list-style-type: none"> <li>Seminar-like teaching</li> <li>Exercises and examples (case studies)</li> <li>Drill and practice</li> </ul>														
6	<b>Vorbedingungen / Vorkenntnisse</b> <i>Prerequisites</i> basic knowledge about plastics and their application														
7	<b>Arbeitsmittel / Literatur</b> <i>Required material / Literature</i> <ul style="list-style-type: none"> <li>Jacobs, O. : Polymer Science, lecture notes, FH Lübeck</li> <li>updated textbook list will be supplied at the beginning of the semester</li> </ul>														

Detailinformationen																				
8	<b>Inhalte</b> <i>Course topics</i> <b>Polymerisation</b> carbon atom and its bonds (single, double, triple, steric structure) radical chain polymerisation, ionic chain polymerisation, step reaction, polycondensation, ring opening polymerisation catalysts and their effect on the chain structure (Zigler-Natta, metallocene) degree of polymerisation, molar mass and their measurement branching ratio <b>Structure property relation</b> constitution (dipoles, voluminous side groups, rigid back bone segments) configuration (tacticity) crystallisation and crystallinity (effect of molecular structure), structural anisotropy and anisotropic properties copolymers (block, random, grafting) <b>Compounding</b> Additives and their effect (fillers, reinforcements, plasifiers, lubricants, release agents, stabilisers etc.) dispersion and homogenisation <b>Rheology of polymers</b> Newtonian and non-Newtonian fluids, power law, shear thinning flow induced anisotropy measurement methods: viscosimeters, MVR/MFR, high pressure capillary rheometer <b>Thermal properties of polymers</b> phase transitions: molecular processes, mathematical models solidification of melts, shrinkage, skin-core morphology in injection moulded parts <b>Mechanical properties of polymers</b> viscoelasticity: energy elasticity, entropy elasticity, creep/relaxation; molecular processes, mathematical models cyclic loading: DMA, effect of temperature and frequency, time/temperature transformations, master curves stress-strain behaviour, creep curves and creep modulus <b>Electrical properties of polymers</b> Conduction mechanisms in polymer compounds, percolation, anti-static compounds Dielectric constant, polarisation mechanisms, frequency effect, practical relevance (capacitors, HF welding, absorption of electromagnetic waves) <b>Environmental effects</b> Diffusion processes in polymers, barrier properties, Chemical interaction with media, oxidation, surface activation Physikal interaction, soaking, softening and internal stresses Radiation effects: radiation induced processes, aging, radiation curing/crosslinking, stabilisers and activators <b>Polymer Processing and Recycling</b> Injection Moulding and derivatives, extrusion and derivatives, thermoforming and derivatives, Differences between thermoplastics, thermosets, and elastomers, Material recycling, recycling to resources, thermal recycling: Practical examples, state of the art and trends																			
9	<b>Prüfungsform</b> <i>Assessment</i> Written examination at the end of the term: 2 hours.																			
10	<b>Voraussetzung für die Vergabe von Kreditpunkten</b> <i>Requirements for granting of credits</i> <ul style="list-style-type: none"> <li>Successful passing of exam</li> </ul>																			
11	<b>Weiterführende Veranstaltungen</b> <i>Related courses</i> <ul style="list-style-type: none"> <li>Composite Materials</li> </ul>																			
12	<b>Zuordnung</b> <i>Classification</i> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 12.5%;">Mathematik &amp; Naturwissenschaft</th> <th style="width: 12.5%;">Ingenieurwissenschaften</th> <th style="width: 12.5%;">Ingenieur-anwendungen</th> <th style="width: 12.5%;">Entwicklung &amp; Konstruktion</th> <th style="width: 12.5%;">Werkstoffe</th> <th style="width: 12.5%;">Wirtschaft, Management, Sprachen</th> <th style="width: 12.5%;">Anderes</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>X</td> <td>X</td> <td></td> <td>X</td> <td></td> <td></td> </tr> </tbody> </table>						Mathematik & Naturwissenschaft	Ingenieurwissenschaften	Ingenieur-anwendungen	Entwicklung & Konstruktion	Werkstoffe	Wirtschaft, Management, Sprachen	Anderes	X	X	X		X		
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13	<b>Modulbeauftragter / Lehrpersonen</b> <i>Responsible person / Lecturers</i> Prof. Dr. O. Jacobs/ Prof. Dr. O. Jacobs																			