

Module title:	MATERIAL SCIENCE AND CHEMISTRY
Module coordinator:	Prof. Dr. Stefan Raber Prof. Dr. Karlheinz Trebesius
Lecturer(s):	Prof. Dr. Stefan Raber Prof. Dr. Karlheinz Trebesius Prof. Dr. Christiane Fritze External lecturers
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 1 st semester
Teaching method: Hours per week (SWS):	Seminars 4 teaching hours
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	None
Overview & applicability:	This module provides important knowledge of material science and chemistry for industrial engineers.
Learning objectives / competencies:	<p>Competence Level 2 „Understand“:</p> <ul style="list-style-type: none"> • Students are able to explain the molecular structure of matter and understand the transformation of matter and energy in chemical reactions. • Students understand the building principles of atoms and molecules. • Students can explain important fundamentals of materials (technical terminology, bonds, etc.). • Students can explain the structure of metallic materials and the importance of structural defects. • Students can describe the mechanical properties of metals and important aspects of application (e.g. strengthening mechanisms). • Students can explain thermally activated processes (diffusion, recrystallisation, etc.). • Students can describe important procedures for materials testing (e.g. tensile tests, etc.). • Students can explain changes in the conditions of metals when adding alloying elements. • Students can explain the principles and applications of metals, such as ferrous and non-ferrous metals. • Students can explain the fundamentals of technical ceramics and polymers in their own words. <p>Competence Level 3 „Apply“:</p> <ul style="list-style-type: none"> • Students are able to use the electron configuration of elements and their position in the periodic table to predict the corresponding chemical behaviour.

	<ul style="list-style-type: none"> • Students are able to formulate situational statements about materials clearly and use the correct technical terminology. <p>Competence Level 4 „Analyse“:</p> <ul style="list-style-type: none"> • Students can categorise functions of materials in terms of their molecular structure and prevailing bonding types. • Students can independently reflect on essential and inessential aspects of technical material questions. • Students can analyse application issues. <p>Competence Level 5</p> <ul style="list-style-type: none"> • Students can independently assess essential and non-essential aspects of materials engineering questions, and are therefore able to choose the best solution for materials-related tasks.
Course content:	<p>Material Science:</p> <ul style="list-style-type: none"> • Basics in materials science (periodic system, bonds, material classes, determining material properties) • Structure of materials • Mechanical properties of metals • Thermally activated processes • Methods of materials testing • Alloys and phase diagrams • Ferrous and non-ferrous metals • Polymers • Technical ceramics <p>Chemistry:</p> <ul style="list-style-type: none"> • Classes of matter • Atomic structure (Bohr model and wave mechanical model) • Periodic table and periodic properties • Intra- and intermolecular chemical bonds • Basics in chemical reactions
Assessment method:	Written exam Duration: 90 minutes
Literature / Recommended reading:	<p>BROWN, Theodore L., LEMAY, H. Eugene, BURSTEN, Bruce E., MURPHY, Catherine J., WOODWARD, Patrick M., STOLTZFUS, Matthew W. C, 2018. <i>Chemistry-The Central Science</i>. 14th Edition. Harlow (United Kingdom): Pearson Education. ISBN-13: 978-1-292-22122-9. ATKINS, Peter W. and JONES, Loretta, 2006. <i>Chemical Principles – The Quest of insight</i>. 7th Edition. Ney York (U.S.A.): W.H. Freeman and Company. ISBN-13 978-1-44664411--88339955--33</p> <p>SHACKELFORD, James F., 2015. <i>Introduction to Materias Science for Engineers</i>. Eighth Edidtion. München: Pearson Studium Verlag. ISBN 978-0-273-79340-3</p>

ASHBY, M.F. und D.R.H. JONES, 2018. *Engineering materials. An introduction to properties, applications and design: 1* [online]. Fifth edition. Amsterdam: Butterworth-Heinemann, ISBN 978-0-08-102051-7

ASHBY, M.F. und D.R.H. JONES, 2013. *Engineering materials. 2: an introduction to microstructures and processing* [online]. 4. ed. Amsterdam: Elsevier. Issn Ser. ISBN 9780080966694