DEPARTMENT OF MATERIALS SCIENCE AND TECHOLOGY
COURSE SYLLABUS

Course Details				
Code	**Academic Year**			**Semester**
MWT202	2			4
Title	**T**	**A**	**L**	**ECTS**
Thermodynamics of Solid-State Material	2	3		6

Language	German					
Level	**Undergraduate**	**X**	**Graduate**		**Postgraduate**	
Department / Program	Materials Science and Technology					
Forms of Teaching and Learning	Face to face					
Course Type	**Compulsory**	**X**	**Elective**			
Objectives	Upon completion of the module, students will develop a first understanding of solid-state thermodynamics and will be able to apply the main concepts of equilibrium thermodynamics. This involves recognizing the various basic types of phase diagrams in binary and ternary state diagrams as well as their derivation from the thermodynamic G-x curves. In addition, they are able to quantitatively determine the phase components as a function of the temperature, even from unknown state diagrams, and to establish the relationship to the structure, microstructure and process parameters					
Content	Basic concepts of thermodynamics (enthalpy, entropy, td equilibrium, td potentials, chemical potential, activity, etc.), introduction of Gibbs', phase rule / degrees of freedom, quantitative treatment of solidification of melts by nucleation and germination, derivation of the various basic types of binary Phase diagrams (complete miscibility, eutectic, peritectic, monotectic) on the basis of the ideal or regular solution and justification by means of Gx curves, partly justification of the appearance of mixed crystals and order phases and the spinodal segregation, discussion of the double tangent rule for the determination of the in td. Balance of existing phases / lever law, presentation of the most important binary real diagrams (iron-carbon diagram, Al-Cu, brass etc.), ternary systems, discussion of the occurrence of metastable phases based on the ZTU diagrams, especially in the Fe-C system.					
Prerequisites						
Coordinator	None					
Lecturer(s)	Dr.-Ing. Cagatay Elibol					
Assistant(s)	None					
Work Placement	No					

Recommended or Required Reading	
Books / Lecture Notes	Dr.-Ing. Cagatay Elibol – Course Scripts
Other Sources	D.A. Porter, K. Easterling, Phase Transformation in Metals and Alloys, 2nd edition, Chapman & Hall, London 1997 G. Gottstein, Physikalische Grundlagen der Metallkunde, Springer 2001, ebook Bargel, Schulze, Werkstoffkunde, Springer 2003, ebook Bücher zur Thermodynamik: Atkins, David R. Gaskell o.ä. R.W. Cahn, P. Haasen, Physical Metallurgy, Part 1, North Holland, Amsterdam, 1996

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	Callister, Materialwissenschaften und Werkstofftechnik, Wiley-VCH, 2012
Additional Course Material	
Documents	
Assignments	
Exams	

Course Composition		
Mathematics und Basic Sciences		%
Engineering		100%
Engineering Design		%
Social Sciences		%
Educational Sciences		%
Natural Sciences		%
Health Sciences		%
Expert Knowledge		%

Assessment		
Activity	**Count**	**Percentage (%)**
Midterm Exam	1	40%
Quiz		
Assignments		
Attendance		
Recitations		
Projects		
Final Exam	1	60%
	Total	**100**

ECTS Points and Work Load			
Activity	**Count**	**Duration**	**Work Load (Hours)**
Lectures	14	2	28
Self-Study	10	10	100
Assignments	2	10	20
Presentation / Seminar Preparation			
Midterm Exam	1	2	2
Recitations	14	2	28
Laboratory			
Projects			
Final Exam	1	2	2

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Total Work Load	**180**
ECTS Points (Total Work Load / Hours)	**6**

Learning Outcomes	
1	Upon completion of the module, students will develop a first understanding of solid-state thermodynamics and will be able to apply the main concepts of equilibrium thermodynamics.
2	
3	

Weekly Content	
1	Basic concepts of thermodynamics (enthalpy, entropy, thermodynamic equilibrium, Thermodynamic potentials, chemical potential, activity etc.)
2	Introduction of the Gibbs phase rule and its effect on the degrees of freedom
3	quantitative treatment of the solidification of melts by nucleation and Germ growth based on the above thermodynamic foundations
4	Derivation of the various basic types of binary phase diagrams (complete Miscibility, eutectic, peritectic, monotectic) based on the ideal or regular Solution and justification by means of G-x-curves
5	Termodynamic justification for the appearance of mixed crystals and phases of order and the spinodal segregation
6	
7	
8	
9	
10	
11	
12	
13	
14	

Contribution of Learning Outcomes to Program Objectives (1-5)

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
1	5	5	5	5	5	5	5
2							
3							

Contribution Level	1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High
Compiled by:	
Date of Compilation:	