DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY
COURSE SYLLABUS

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

Language	German					
Level	**Undergraduate**	**X**	**Graduate**		**Postgraduate**	
Department / Program	Department of Material Science and Technology					
Forms of Teaching and Learning	Face to Face					
Course Type	**Compulsory**	**X**	**Elective**			
Objectives	-Learning important physical and thermodynamic fundamental terms -To understand how different microstructures and phase transformations occur.					
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	None					
Coordinator	None					
Lecturer(s)	Asist Prof.Dr. Çağatay Elibol					
Assistant(s)	None					
Work Placement	No					

Recommended or Required Reading	
Books / Lecture Notes	B.S.Bokstein, M.I.Mendelev, D.J. Srolovitz: “Thermodynamics & Kinetics in Materials Science”, Oxford University Press (2005)
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 Atkins, David R. Gaskell o.ä. R.W. Cahn, P. Haasen, Physical Metallurgy, Part 1, North Holland, Amsterdam, 1996 Callister, Materialwissenschaften und Werkstofftechnik, Wiley-VCH, 2012

Additional Course Material	
Documents	

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Assignments		
Exams		

Course Composition		
Mathematics und Basic Sciences		%
Engineering		80%
Engineering Design		%
Social Sciences		%
Educational Sciences		%
Natural Sciences		%
Health Sciences		%
Expert Knowledge		20%

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	12	10	120
Assignments			
Presentation / Seminar Preparation			
Midterm Exam	1	3	3
Recitations	14	2	28
Laboratory			
Projects			
Final Exam	1	3	3
		Total Work Load	**182**
		ECTS Points (Total Work Load / Hours)	**6**

Learning Outcomes

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1	Thermodynamic understanding of the driving forces for presence of various microstructures in materials.
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Weekly Content	
1	Fundamentals
2	Basic concepts of thermodynamics (enthalpy, entropy, thermodynamic equilibrium, thermodynamic potential, chemical potential, activity, etc.)
3	Basic concepts of thermodynamics (enthalpy, entropy, thermodynamic equilibrium, thermodynamic potential, chemical potential, activity, etc.)
4	Gibbs phase rule and its effect on degrees of freedom
5	Quantitative analysis of nucleation and growth and solidification of solutions
6	Basic types of binary phase diagrams (full miscibility, eutectic, peritectic, monotectic)
7	Basic types of binary phase diagrams (full miscibility, eutectic, peritectic, monotectic)
8	Thermodynamic explanation of the formation of solid solutions and their ordered phases as well as spinodal segregation
9	Double tangent rule for determining phases in thermodynamic equilibrium
10	Leverage rule for quantitative determination of phase fraction
11	Qualitative relationships between cooling rate and microstructure on the basis of cooling curves
12	Important binary real diagrams (iron-carbon diagram, Al-Cu, brass)
13	Discussion of the formation of metastable phases on the basis of TTT diagrams (Fe-C)
14	Triple systems
15	

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

	P1	P2	P3	P4	P5	P6	P7	P8
1	3	4	5	2	3	3	1	2
2								
3								

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4								
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12								

Contribution Level	1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High
https://obs.tau.edu.tr/oibs/bologna/progLearnOutcomes.aspx?lang=en&curSunit=207	
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