DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY
COURSE SYLLABUS

Course Details				
Code	**Academic Year**			**Semester**
MWT408	3			6
Title	**T**	**A**	**L**	**ECTS**
Advanced Characterization Techniques of Materials	2	1	1	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**		**Elective**	X		
Objectives	Primary aim of the lecture is to equip students with a comprehensive understanding of sophisticated methods in material characterization. The lecture covers general principles and operation of instruments such as electron microscopes, X-ray diffractometer, and various spectroscopy techniques. The course delves into microstructural analysis, chemical analysis, and mechanical/thermal characterization. The focus is on understanding complex data and applying techniques in real-world situations. Through hands-on experience, students develop critical thinking skills, connecting theory to practical applications in materials science research and industry.					
Content	The course content covers microscopy techniques such as Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and Atomic Force Microscopy (AFM), Spectroscopic methods such as X-ray Photoelectron Spectroscopy (XPS) and Fourier Transform Infrared Spectroscopy (FTIR), along with diffraction techniques like X-ray Diffraction (XRD). Chemical analysis methods, mechanical and thermal analysis techniques will be covered. Examples and real-world uses will show how these methods matter in studying materials, giving a complete view of their practical effects. The course will also look into new methods and changes happening in the field of understanding materials.					
Prerequisites	None					
Coordinator	Head of Deparment					
Lecturer(s)	Assoc. Prof. Dr. Ergün Keleşoğlu					
Assistant(s)						
Work Placement						

Recommended or Required Reading	
Books / Lecture Notes	
Other Sources	Alford, T.L., Feldman, F.C., Mayer, W., Fundamentals of Nanoscale Film Analysis,Springer, 2007 Dinardo, N.J., Nanoscale Characterization of Surfaces and Interfaces. 2nd ed., Wiley-VCH. 2004. Golstein, J., Scanning Electron Microscopy and X-Ram Microanalysis. 3rd ed., Springer,2003. Watts, J.F., An Introduction to Surface Analysis by XPS and AES, Wiler 2003. Wang, Z.L., Characterization of Nanophase Materials. Wiley-VCH, 2000. Weinheim, E.L., X-ray characterization of materials, Wiley-VCH, 1999.
Additional Course Material	

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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			
Presentation / Seminar Preparation			
Midterm Exam	1	2	2
Recitations	15	1	15
Laboratory	15	2	30
Projects			
Final Exam	1	2	2
		Total Work Load	**177**
		ECTS Points (Total Work Load / Hours)	**6**

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Learning Outcomes	
1	Obtaining a proficient understanding of advanced characterization techniques in materials science, including microscopy, spectroscopy, diffraction, chemical analysis, and mechanical/thermal analysis.
2	Acquiring hands-on experience and technical skills in operating sophisticated instruments such as electron microscopes and diffraction devices used in materials characterization.
3	Developing the ability to analyze complex data generated by advanced characterization techniques.
4	Understanding the practical applications of characterization techniques through case studies.
5	Gaining awareness of emerging techniques and current trends in the field of materials characterization.

Weekly Content	
1	Introduction to Materials Characterization – General overview of materials characterization
2	Introduction to Materials Characterization – Fundamentals of various techniques
3	Microscopy Techniques - Confocal Microscopy and Optical Microscopy
4	Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM)
5	Atomic Force Microscopy (AFM) and Scanning Tunneling Microscopy (STM)
6	X-ray Photoelectron Spectroscopy (XPS) and Auger Electron Spectroscopy (AES)
7	Fourier Transform Infrared Spectroscopy (FTIR) and Raman Spectroscopy
8	Nuclear Magnetic Resonance (NMR) Spectroscopy
9	Diffraction Techniques - X-Ray Diffraction
10	Electron and Neutron Diffraction
11	Mass Spectrometry
12	Energy-Dispersive X-ray Spectroscopy (EDS) and Wavelength-Dispersive X-ray Spectroscopy (WDS)
13	Mechanical and Thermal Analysis
14	Emerging Techniques and Review

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

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

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

Compiled by:	Assoc. Prof. Dr. Ergün Keleşoğlu
Date of Compilation:	01.11.2023