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| Course Title | **Characterization Techniques of Bulk and Nano-Materials** | | | | |
| Course Code | **MME 554** | | | | |
| Course Type | **Compulsary** | | | | |
| Level | Graduate | | | | |
| Year / Semester | Spring Semester | | | | |
| Teacher's Name | Theodora Kyratsi | | | | |
| ECTS | 8 | Lectures / week | 2x1.5 hrs | Laboratories / week | 1 |
| Course Purpose and Objectives | To understand the principles, methodology, limitations and possible applications of a wide range of characterization. | | | | |
| Learning Outcomes | The students will be able to:<br>1. Describe methodology-capabilities-limitations of typical measurements techniques for structural characterization (Powder X-Ray Diffraction, Elemental Analysis) and their application at single/multiphase materials and macro- and nano-scale.<br>2. Analyze Powder X-ray Diffraction patterns based on available databases; identification; multiphase materials; qualitative and quantitative analysis; size strain.<br>3. Describe methodology-capabilities-limitations of microscopy techniques (Optical Microscopy, Scanning Electron Microscopy, and Scanning Probe Microscopy) and their application at single/multiphase materials and macro- and nano-scale.<br>4. Run typical experiments on Powder X Ray Diffraction, Scanning Electron Microscope, Elemental Analysis via Energy Dispersive Spectroscopy and Thermal Analysis.<br>5. Describe methodology-capabilities-limitations of spectroscopic characterization techniques (Vibrational, Visible and Ultraviolet, Nuclear Magnetic Resonance, Electron Spin Resonance, X-ray, Electron spectroscopies etc) and their application at single/multiphase materials and macro- and nano-scale.<br>6. Decide/Select/Combine various complementary techniques depending on case studies. | | | | |
| Prerequisites | NO | Required | NO | | |
| Course Content | The course is designed to develop an understanding of materials characterization techniques used in materials science and engineering. Diffraction techniques: X-ray, electron and neutron diffraction. Microscopic techniques: Electron, Atomic Force Microscopy. Spectroscopic techniques: Vibrational, Visible and Ultraviolet, Nuclear Magnetic Resonance, Electron Spin Resonance, X-ray, Electron | | | | |

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| | spectroscopies. Other techniques: thermal, electrical, mechanical, magnetic characterization.<br>The course includes demonstrations and/or lab experiments:<br>• Powder X-Ray Diffraction<br>• Scanning Electron Microscopy<br>• Elemental Analysis via Energy Dispersive Spectroscopy<br>• Thermal Analysis |
| Teaching Methodology | Lectures, ppt presentations, labs<br>Communicative, Collaborative<br>During the first week of the semester, the Syllabus of the course is given by the teacher, which includes information on the course content, expected learning outcomes, assessment and office hours |
| Bibliography | • Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Prof. Yang Leng, Wiley, 2013, Online ISBN: 9783527670772<br>• Materials Characterization Techniques, Sam Zhang, Lin Li, Ashok Kumar, CRC Press, 2008, ISBN: 9781420042948<br>• ASM handbook / prepared under the direction of the ASM International Handbook Committee, Vol 10 Materials Characterization, 1991, ISBN: 978-0-87170-016-2<br>• Elements of X-ray diffraction / B.D. Cullity, S.R. Stock, 2001, ISBN: 978-0201610918<br>• Selected articles |
| Assessment | Midterm exam (25%), final exam (40%), presentation (25%), lab (10%) |
| Language | English |