Courses in English
Course Description

Department	06 Applied Sciences and Mechatronics
Course title	**Photoacoustics for Material Characterization (MNM370)**
Hours per week (SWS)	4
Number of ECTS credits	6
Course objective	Photoacoustics for material characterization is a course of specific applications for MNT and POM. Students will be introduced to the fast growing research field of photoacoustics that can be applied to a range of industrial and medical applications. Students will develop an understanding of how theoretical knowledge is used to guide various applications. The course covers the key photoacoustical and photothermal theories, models and measurement techniques relating to development of application skills. In this module students will be introduced to various related topics in skill acquisition. Students will learn how ultrasonic waves and thermal waves are generated, propagated and detected by using lasers and optical techniques and will be introduced theoretically and experimentally to noncontact and nondestructive material testing expertise and proficiency. Industrial examples and applications from current research across a wide spectrum of technical domains (layered materials and structures, composites, semiconductor and biomedical tissues, etc.) will be analyzed, discussed and evaluated.
Prerequisites	Waves and Fields in Physics
Recommended reading	Rosencwaig A., Photoacoustics and Photoacoustic Spectroscopy Mandelis A., Photoacoustic and Thermal Wave Phenomena in Semiconductors Wang L. H., Photoacoustic Imaging and spectroscopy Wang L. H., Biomedical Optics: Principles and Imaging Mandelis A., Diffusion-Wave Fields Schmerr L. Fundamentals of Ultrasonic Phased Arrays (8) Scruby C. B., Drain L. E., Laser Ultrasonics Techniques and Applications (9) Rose J. L., Ultrasonic Guided Waves in Solid Media (10) Davies E. R., Electronics Noise and Signal Recovery (11) Almond D. P., Patel P. M., Photothermal Science and Techniques (12) Carslaw H. S., Jaeger J. C., Conduction of Heat in Solids
Teaching methods	lecture with exercises and experiments
Assessment methods	60% written exam, 40% Colloquium
Language of instruction	English
Name of lecturer	Prof. Datong Wu / Dr. Matthias Goldammer (Siemens)
Email	datong.wu@hm.edu
Link	https://sci-intern.hm.edu/fk/modulbeschreibungen.php?lang_nr=&id=1898
Course content	Photoacoustic and Photothermal Effects: Background of photoacoustic and photothermal Sciences, photoacoustic spectroscopic systems and system design issues. Ultrasonic Waves and thermal waves: Propagation of elastic waves (P-waves, S-waves, Rayleigh waves and Lamb waves) in solids and layered materials, optical generation and optical detection of ultrasonic waves, optical measurement techniques, properties of thermal waves, thermographic measurement systems. Signal recovery and image processing: Signal and noise analysis methods, signal recovery techniques, photoacoustic imaging in biomedicine, radon-transformation and reconstruction technique for photoacoustic tomography. Industrial Applications: Photoacoustics and photothermal technique in industrial nondestructive evaluations of various kind of materials (layered materials and structures, composites, semiconductor and biomedical tissues, etc.). Industrial examples and applications from current research will be analyzed, discussed and evaluated.