

Course title: Advanced Surface Testing Techniques	Neptun code: GEMTT546-a
Course coordinator: name, position, scientific degree Prof. Dr. Maria Berkes Maros, Full professor, PhD. Dr. habil.	
type and number of lessons: lecture/seminar/practical lesson/consultation ... / week or semester 4×2 hours lecture + 10×2 hours consultation / semester	
method of accountability (colloquium/practical mark/other): colloquium	
curriculum location of the subject (autumn/spring): spring	
pre-study conditions: –	
The task and purpose of the subject:	
The course task is to make students familiar with the state-of-the-art methods of materials testing to characterise the physical, mechanical, tribological, structural and surface topographical characteristics of engineering structures. The course aims to enable PhD students to characterise surfaces, surface layers and thin films subjected to various stresses and to investigate their application properties to prevent the causes of their deterioration, improve their resistance to such stresses and enhance the performance of engineering structures.	
Course description:	
The purpose, measurement methods and applications of surface testing. Theoretical and experimental investigation of damage to gradient and heterogeneous surfaces, complex characterisation of surface layers and coatings. Surface physics aspects of tribological damage (atomistic approach to surface tension, adhesion, friction). Methods and tools for surface geometry investigations (2D and 3D roughness parameters). Determination of micro- and nano-level characteristics of surface mechanical properties (micro- and nanoscale, micro- and nanohardness, micro- and nanotribological investigations). Microstructural characterisation of surface layers and coatings at different levels of length-scale (e.g. optical, SEM, TEM, AFM, XRD, EDX, Raman spectroscopy). Nanomechanical characterisation of surface layers and thin films. Applications in engineering practice (thin films, diffusion and coating layers, micro- and nanocomposites, MEMS/NEMS devices, magnetic storage systems, etc.)	
Required literature:	
<ol style="list-style-type: none"> 1. B. BHUSHAN: Modern Tribology Handbook, Volume One, CRC Press, ISBN0-8493-8403-6, 2001. p1760 2. O'CONNOR, D. J., SEXTON, B. A.: Surface Analysis Methods in Materials Science, Springer, 2003. pp1-585 3. VICKERMAN, J.C., GILMORE, I.: Surface Analysis: The Principal Techniques, 2nd Ed. Wiley, 2009. p686 	
Recommended literature:	
<ol style="list-style-type: none"> 1. D. DOWSON: Experimental methods in tribology, Tribology series 44. Elsevier 2004. ISBN: 0 444 51589 5 2. WATTS, J. F., WOLSTENHOLME, J.: An Introduction to Surface Analysis by XPS and AES, John Wiley & Sons, 2003., p212. 3. PAKSERESHT, A., SHARIFAHMADIAN, O.: Handbook of Research on Tribology in Coatings and Surface Treatment, IGI Publishing, ISBN13: 9781799896838, 2022. p470. DOI: 10.4018/978-1-7998-9683-8 	