



## KAUNAS UNIVERSITY OF TECHNOLOGY

### STUDY MODULE PROGRAMME (SMP)

Module Code	T	150	B	186	Accredited until	2024	09	01	Renewal date		
	Branch of Science		Progr.	Registr. №.							

Entitlement

Functional Materials and Nanotechnologies
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Prerequisites

Basics of Physics and Mathematics
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Main aim

To teach the basic knowledge about functional materials, modern methods of nanotechnologies, instrumentation and its applications for creation of extremely small devices
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Course (module) Learning Outcomes

№.	Outcomes	Teaching / Learning Methods	Assessment Methods
1	Is able to define the structure and properties of advanced functional materials	Lecture	Mid-term examination
2	Know and understand the basic principles of operation of atomic force and scanning tunneling microscope	Lecture	Mid-term examination
3	Understand and is able to adapt nanoprobe and perform measurements with atomic force microscope	Laboratory classes	Laboratory examination
4	Is able to define methods of micro- and nanotechnology	Lecture	Written examination
5	Is able to perform processes of microlithography	Laboratory classes	Laboratory examination
6	Is able to define fabrication principles of micro- and nanoelectromechanical systems	Lecture	Written examination
7	Is able to evaluate micro- and nanodevices by optical and scanning electron microscope	Laboratory classes	Laboratory examination
8	Is able to present the results of scientific literature analysis	Individual project	Paper

Summary

Theoretical knowledge on structure and properties of advanced functional materials will be assimilated. After completion of course students will know and understand the principles of operation of atomic force and scanning tunneling microscope as well as technological specialities of micro- and nanoelectromechanical systems. The students will be taught to adapt cantilever and perform measurements of functional materials by atomic force and scanning electron microscope. After completion of course students will be able to use the surface and bulk micromachining technologies, to make ordered microstructures in thin films for micro- and nanodevices.
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Level of module

Level of programme		Subject group
Cycle	Degree	
First	Bachelor	
		Special Subjects

Syllabus

№.	Sections and themes
1.	Functional materials and nanoscopic control methods
1.1	Classification of functional materials
1.2	Interatomic and intermolecular bonds in materials
1.3	Crystal structure and defects
1.4	Status diagrams and phase transitions
1.5	Nanoprobes. Atomic force microscopy
1.6	Scanning tunneling microscopy
2.	Nanotechnology techniques and nanodevices
2.1	Methods of micro- and nanotechnology

№.	Sections and themes
2.2	Nanoimprint lithography
2.3	Electron beam nanolithography
2.4	Atomic lithography and three dimensional nanostructures
2.5	Micro- and nanoelectromechanical system technologies
2.6	Surface and bulk micromachining
2.7	Thin film etching, Bosch process
2.8	Functional micro- and nanodevices

Evaluation procedure of knowledge and abilities:

The ten-grade scale and the cumulative evaluation system are applied. The module's final evaluation consists of the sum of multiplications of the grades of the intermediate assessments and the final assessment multiplied by weighting coefficients (percentage components).

#### References

№.	Title	Edition in KTU library		In KTU bookstore	Number of ex. in the methodical cabinet of the depart.
		Pressmark	Number of exemplars		
1.	Jonas Vilyis, Sigitas Tamulevičius, Viktoras Grigaliūnas, Šarūnas Meškiniš, Asta Guobienė. Paviršiaus inžinerija ir nanotechnologijos. Mokomoji knyga. Kaunas: Vitae Litera, 2007. 225 psl.	D198358	16	Yes	
2.	Sigitas Tamulevičius, Dalius Jucius. Medžiagu mokslas. Mokomoji knyga. Kaunas: Vitae Litera, 2007. 198 psl.	D198372	16	Yes	
3.	Fundamentals of materials science and engineering: an interactive e. text / William D. Callister. Callister, William D. New York : John Wiley & Sons, 2001, 5th ed., 524 p. + 1 CD-ROM	E27419	1	No	
4.	Advanced functional materials / edited by Ashutosh Tiwari and Lokman Uzun. Hoboken [N.J.] : Wiley, 2015. 573 p.	D215098	1	No	

#### Additional literature

№.	Title
1.	An introduction to nanoscience and nanotechnology / Alain Nouailhat. New York : John Wiley & Sons, 2008, 229 p., prieiga per internetą: <a href="http://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf">http://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf</a>
2.	<a href="http://www.afmworkshop.com/atomic-force-microscope-animated-tutorials/">http://www.afmworkshop.com/atomic-force-microscope-animated-tutorials/</a>

#### Lecturer

	Position	Name, surname
Coordinating	General Research Assistant	Viktoras GRIGALIŪNAS

#### Subdivision

	Entitlement	Code	Contribution, %
Atsakingas padalinys	Institute of Materials Science	70	100

#### Languages of instruction

Autumn semester:	Lithuanian, English
Spring semester:	Lithuanian, English

#### Teaching form

№.	Mode of studies	Semester		Structure					Total hours	Credits
				Lectures	Practical (supervised)	Laboratory (supervised)	Tutorial	Independent Learning		
1	Standard	A	S	32	0	16	0	112	160	6

Teaching form Standard



