KAUNAS UNIVERSITY OF TECHNOLOGY

STUDY MODULE PROGRAMME (SMP)

Module Code	T	165	M	001	Accredited until	2025	09	01	Renewal date		
	Branch of Science		Progr.	Registr. №.							

Entitlement

Optical Technologies and Spectroscopy

Prerequisites

Basic knowledge in Physics, Mathematics and Informatics

Main aim

To know principles of micro- and nanostructures formation employing laser based technologies and spectroscopic methods applied for characterization. To obtain practical knowledge in formation and analysis of nanostructures.

Course (module) Learning Outcomes

№.	Outcomes	Teaching / Learning Methods	Assessment Methods
1	Is able to define basic design and modelling pricipals of micro- and nanostructures.	Laboratory classes, Lecture, Team project	Laboratory examination, Oral examination , Project report
2	Is able to design the pattern of nanoobjects and predict their optical response.	Laboratory classes, Lecture, Team project	Laboratory examination, Oral examination , Project report
3	Is able to create nanobject employing continuous wave and femtosecond pulsed lasers.	Laboratory classes, Lecture, Team project	Laboratory examination, Oral examination , Project report
4	Is able to proceed the measurements of the micro and nanostructures with spectroscopic equipment.	Laboratory classes, Lecture, Team project	Laboratory examination, Oral examination , Project report
5	Is able to choose the best analytical technique for characterization of nanostructures and is able to interpret the results.	Laboratory classes, Lecture, Team project	Laboratory examination, Oral examination , Project report

Summary

The working principles of continuous wave and ultrashort pulsed laser and its application for micro- and nanostructures and devices formation is acquired. Students will be able to choose spectroscopic method for analysis of different nanostructures, to obtain and interpret results.

Level of module

Level of programme		Subject group	Subject level
Cycle	Degree		
Second	Master	Special Subjects	Deepening

Syllabus

№.	Sections and themes
1.	Design, modelling and simulation of nanostructures.
2.	Intensive laser radiation work safety issues.
3.	Fabrication of micro- and nanoobjects employing continouos wave laser.
4.	Fabrication of micro- and nanoobjects employing ultrashort laser pulses.
5.	Application of UV/VIS and fluorescence spectroscopy in the analysis of micro and nanostructures.
6.	Principles and applications of Raman microspectroscopy and surface enhanced Raman spectroscopy (SERS).
7.	Fourier transform infrared spectroscopy (FTIR and NIR).
8.	Pump-probe spectroscopy. Principles and analysis of results.
9.	Spectroscopic ellipsometry. Principles and application for analysis of nanoobjects.

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.	Bahaa E. Saleh, Teich, Malvin Carl, Fundamentals of photonics // Wiley-Interscience, 2007, 1171 p.	E29645	2	No	
2.	Demtroder, W., Laser spectroscopy Vol. 1 // Springer, 457 p.	-	0	No	
	Comment:Available at Institute of Materials Science				
3.	Demtroder, W., Laser spectroscopy Vol. 2 // Springer, 697 p.			No	
	Comment:Available at Institute of Materials Science				
4.	Guobienė, A. ir kt., Medžiagų mokslas: laboratoriniai darbai. Mokomoji knyga // Dakra, 2013, 130 p.			No	60
	Comment:Available at Institute of Materials Science				
5.	Fujiwara, H., Spectroscopic Ellipsometry: Principles and Applications // Wiley & Sons, 2007, 369 p.			No	
6.	Barat,K., Laser Safety in the Lab // SPIE press, 2013, 166 p.			No	

Additional literature

№.	Title
1.	Schäfer, M., Computational engineering - introduction to numerical methods, Springer, 2006, 321 p. (Electronic version)
2.	Lakowicz, J.R., Principles of fluorescence spectroscopy, Springer, 2006, 954 p. (KTU library: E29681)
3.	Vandenabeele, P., Practical Raman spectroscopy : an introduction, Wiley, 2013, 161 p. (KTU library: D215099)
4.	Diem, M., Modern vibrational spectroscopy and micro-spectroscopy [elektroninis išteklius] : theory, instrumentation, and biomedical applications, Wiley, 2015, 411 p.

Lecturer

	Position	Name, surname
Coordinating	Assoc. professor	Asta TAMULEVIČIENĖ

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	10	28	22	4	96	160	6

Teaching form Standard

Schedule of individual work tasks and their influence on final grade

Assessment form	Final Assessment	№. of syllabus	Total hours	Influence on grade, %	Week of presentment of task (*) and reporting (o)															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17-20
Laboratory examination		3-9	18	30		*	*	o	*	*	o	*	o	o							
Project report		1-9	38	30								*								o	
Oral examination	√	1-9	40	40								*									o
Total:	-	-	96	100																	

Assessment criteria and connection to the study module's study results

Assessment form	Assessment week	Assessment criteria	Course (module) Learning Outcomes
Laboratory examination	4, 7, 9, 10	• Student is able to summarize the findings observed during the performing of the lab works. Student understands the meaning of the obtained results, is able to compare the obtained results with the ones found in literature, write a meaningful conclusion. Evaluation is negative (0-4) when the answers to the questions are incomplete and very fragmented, the topic is unknown, the graphical material, equations and their solutions are unknown and it is not possible to answer additional questions. Positive evaluation (10) is given when the answers to the questions are presented in a consistent, clear manner, formulas with explanations are used, which explain the phenomena / processes in question, graphical dependencies are presented, schemes with explanations are given, and examples are applied in practice.	• Is able to choose the best analytical technique for characterization of nanostructures and is able to interpret the results. • Is able to create nanobject employing continuous wave and femtosecond pulsed lasers. • Is able to define basic design and modelling pricipals of micro- and nanostructures. • Is able to design the pattern of nanoobjects and predict their optical response. • Is able to proceed the measurements of the micro and nanostructures with spectroscopic equipment.
Project report	16	• It is assessed how the author of the project managed to understand the solution of the raised and formulated problem, to formulate the goal and objectives. It is assessed whether the selected path for problem solving has been chosen correctly and whether the best technological and analytical facilities were chosen. Evaluation: 0-4 (Unsatisfactory) is assessed	• Is able to choose the best analytical technique for characterization of nanostructures and is able to interpret the results. • Is able to create nanobject employing continuous wave and femtosecond pulsed lasers.

Assessment form	Assessment week	Assessment criteria	Course (module) Learning Outcomes
		if the author of the work does not understand the raised and formulated problem, does not achieve the set goal (s), does not fulfill the set tasks. Such an assessment may also be dictated if the fact of plagiarism is determined. 10 (Excellent) is assessed when the work meets all the above criteria, the topic is relevant, complex, and analyzed in detail using the knowledge gained during the participation in the module.	• Is able to define basic design and modelling pricipals of micro- and nanostructures. • Is able to design the pattern of nanoobjects and predict their optical response. • Is able to proceed the measurements of the micro and nanostructures with spectroscopic equipment.
Oral examination	17	• It is assesed the ability to present the relevance of the chosen topic, experimentally obtained results and their analysis in the audience. The evaluation consists of: presentation (60%) and answers to the questions (Q&A session) (40%).	• Is able to choose the best analytical technique for characterization of nanostructures and is able to interpret the results. • Is able to create nanobject employing continuous wave and femtosecond pulsed lasers. • Is able to define basic design and modelling pricipals of micro- and nanostructures. • Is able to design the pattern of nanoobjects and predict their optical response. • Is able to proceed the measurements of the micro and nanostructures with spectroscopic equipment.