



COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Physics and technology of disordered materials	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: dr. Kristijonas Genevičius	Faculty of Physics
Other(s):	

Study cycle	Type of the course unit (module)
Second (master cycle)	

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Lectures, seminars, laboratory works	III (Autumn) semester	Lithuanian / English

Requirements for students	
Prerequisites: Knowledges of Mathematics, Quantum Mechanics, Solid State Physics	Additional requirements (if any):

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	140	56	84

Purpose of the course unit (module): programme competences to be developed
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The purpose of the course is to provide knowledge of physics and technology of disordered materials; to demonstrate how structure of material is influencing density of states (DOS), optical properties, charge carrier photo-generation, transport and recombination; to show how this theoretical knowledge could be applied in preparation of layers or devices; to provide theoretical and practical background of techniques for investigation of charge carriers transport.

Learning outcomes of the course unit (module)	Teaching and learning methods	Assessment methods
Ability of the student to apply theoretical knowledge for the investigation of properties of charge carrier transport parameters using various investigation methods: TOF, CELIV, DoI.	Laboratory works	Control questions, evaluation of results, reports and conclusions.
Ability to study and understand the newest scientific papers about physics and structures on the base of disordered materials.	Seminars	Evaluation if student is able independently to use and operate knowledges given in lectures.
Acquisition of theory knowledge required for solution of practical problems of technology and physics of disordered materials; ability to understand the literature about disordered materials and devices.	Lectures	Exam in written form.

Content: breakdown of the topics	Contact hours						Self-study work: time and assignments		
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work	Contact hours	Self-study hours	Assignments
1. General principles of formation and description of disordered materials and their relations with physics of crystalline materials. Density of states of disordered materials, criterium of Mott's transition and Andersen's localization of electron.	4		2				6	10	Preparation for reports writing. Repetition for exam.
2. Optical features. Photogeneration of charge carriers (Onzager's model) and recombination (Langevin's model). Charge carrier transport. Stochastic transport: influence of energetic and space disorder. Mott's law.	6		2		2		10	16	Preparation for reports writing. Repetition for exam.
3. Investigation methods and technique of optical, electrical and photoelectrical features of disordered materials.	6		2		2		10	16	Preparation for laboratory works, reports writing. Repetition for exam.
4. Technologies of disordered materials: thermal deposition, sputtering, glow discharge CVD, hot wire CVD, deposition from solutions, spraying and etc.	4		2		2		8	10	Preparation for laboratory works, reports writing. Repetition for exam.
5. Application of disordered material structures in electrophotography, thin film optoelectronics (FET, IC, LED).	3		2		2		7	10	Preparation for laboratory works, reports writing. Repetition for exam.
6. Physics and technology of thin film solar cells. Thin film solar cells of inorganic materials: c-Si, a-Si:H, CIGS, CIS, GaAs and A ₃ B ₅ compounds.	6		4				10	12	Preparation for reports writing. Repetition for exam.
7. Organic thin film solar cells: layered structure, bulk heterojunction, tandem.	3		2				5	10	Preparation for reports writing. Repetition for exam.
Total	32		16		8		56	84	

Assessment strategy	Weight, %	Deadline	Assessment criteria
Laboratory work rating	30*	All course	Preparation to answer theoretical questions, the quality of the work description, ability to describe the results. Evaluation in 10 scores system, the final score is multiplied by the weight coefficient. * It is obligatory to finish 4 laboratory works.
Seminars rating	10	All course	Ability to understand and accomplish the problems during the seminars
Exam (written form)	60	During the exam session	3 open questions. Assessment of answer particularity, consistency and mistakes.

Author	Year of publication	Title	Issue of a periodical or volume of a publication	Publishing place and house or web link
Compulsory reading				
P.M. Ossi	2002	Disordered Materials: an introduction		Springer (Available at VU library as 539.2/Os44) ISBN-13: 978-3540413288 ISBN-10: 3540413286
K. Morigaki	1999	Physics of Amorphous Semiconductors		Semiconductors, World Scientific Publishing Company (Available at VU library as 621.382/Mo191) ISBN 981-02-1381-6
Ed. J. Poortsmans and V. Arkhipov.	2006	Thin Film Solar Cells: Fabrication, Characterization and Applications.		John Wiley & Sons Ltd., England (Available at VU library as 621.383/Po156)
Optional reading				
David I. Bower.	2002	An Introduction to Polymer Physics		Cambridge University Press ISBN-13: 978-0521637213 ISBN-10: 052163721X
C. Brabec, V. Dyakonov, J. Parisi,	2006	Organic Photovoltaics: Concepts and Realization		Springer Series in Materials Science, Springer ISBN-13: 978-3540004059 ISBN-10: 354000405X
Edited by S. Baranovski	2006	Charge Transport in Disordered Solids with Applications in Electronics	Wiley Series in Materials for Electronic & Optoelectronic Applications	John Wiley & Sons DOI:10.1002/0470095067