COURSE UNIT DESCRIPTION

Course unit title	Code
Visual programming and computerized measurements **(Vizualusis programavimas ir kompiuterizuotieji matavimai)**	

Annotation
Visual Programming and Computerized Measurements is a course that introduces students to the principles of computerized measurement systems and virtual instrumentation. During the course, students learn to develop basic data-acquisition and processing applications in the LabVIEW programming environment, select appropriate sensors for specific measurement tasks, analyze the structure of measuring instruments, and apply physics principles to the design of computerized measurement devices.

Lecturer(s)	Department, Faculty
Coordinating: doc. dr. Saulius Nargelas, dr. Mindaugas Viliūnas	Faculty of Physics

Study cycle	Type of the course unit
Bachelor	Individual Studies

Mode of delivery	Semester or period when it is delivered	Language of instruction
Auditory and remote teaching	Autumn semester	English

Requisites	
Prerequisites: Students are expected to have completed general physics courses in mechanics, thermodynamics, electricity, and magnetism.	**Co-requisites (if relevant):** None

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5	140	64	76

Purpose of the course unit: programme competences to be developed
Upon completion of this course, students will be able to: • develop basic virtual instruments for data acquisition and processing in the LabVIEW programming environment;

- address questions related to selecting the most suitable sensor for a given measurement;
- understand and analyze the structure of a measuring instrument;
- apply their existing physics knowledge to the development of computerized measuring instruments.

Learning outcomes of the course unit	Teaching and learning methods	Assessment methods
Acquiring visual programming skills in the LabVIEW environment.	Lectures, Labwork, Homework	Homework, Labwork, Exam
Acquiring the ability to develop virtual measuring instruments in the LabVIEW environment.	Lectures, Labwork, Homework	Homework, Labwork, Exam
Gaining knowledge of sensors.	Lectures	Exam
Gaining knowledge of the types and operation of analog-to-digital converters.	Lectures, Labwork	Labwork, Exam
Gaining knowledge of analog signal processing.	Lectures, Labwork	Labwork, Exam
Developing an understanding of the structure of measuring instruments.	Lectures, Labwork	Labwork, Exam

Course content: breakdown of the topics	Contact hours							Individual work: time and assignments	
	Lectures	Tutorials	Seminars	Workshops	Laboratory work	Internship/work placement	**Contact hours, total**	**Individual work**	**Assignments**
Introduction. Automation of physical experiments and data transformation. Introduction to the LabVIEW graphical programming environment.	2						**2**		
Virtual Instruments. Front panel and block diagram; input and output variables, their types, and mathematical functions. SubVIs.	2				2		**4**	**4**	Analysis of lecture materials, preparation for laboratory work, and homework.
Structures. For and while loops, shift registers, feedback, and conditional statements.	2				4		**8**	**8**	Analysis of lecture materials, preparation for laboratory work, and homework.
Programming Techniques. Sequential programming, parallel programming, state-machine architecture, and event-driven programming.	4				4		**8**	**90**	Analysis of lecture materials, preparation for laboratory work, and homework.
Multidimensional Variables. Arrays, matrices, and clusters. Mathematical operations.	3				2		**5**	**5**	Analysis of lecture materials, preparation for laboratory work, and homework.
Data Display. Charts and graphs.	2				2		**4**	**5**	Analysis of lecture materials, preparation for laboratory work, and homework.
Data Input and Output. Types of text files. Writing to and reading from text files.	2				2		**4**	**5**	Analysis of lecture materials, preparation for laboratory work, and homework.
Measurement Methods and Sensors. Spatial measurements. Duration and	13				6		**23**	**18**	More detailed study of one of the measurement fields covered in the lectures and preparation for a

frequency measurements. Measurement of mechanical quantities in solids and fluids. Temperature measurements. Measurement of electrical and magnetic quantities. Optical measurements. Radiation measurements. Typical Sensor Connection Methods. Measurement bridge circuits. Errors and their compensation. Overload protection.									seminar presentation.
Sampling of Analog Signals. Types of analog-to-digital converters: dual-slope integrating, successive approximation, flash, sigma-delta, hybrid, and pipeline converters. Gray code. The effect of sampling-frequency instability on converter accuracy.	2				10		**12**	**18**	Analysis of lecture materials, preparation for laboratory work, and processing of the results.
Total	32				**32**		**64**	**76**	

Assessment strategy	Weight %	Deadline	Assessment criteria
Labworks and homeworks	50	All semester	Theoretical knowledge of the course, the ability to analyze problematic aspects of visual programming, and the application of theoretical knowledge to the solution of specific practical tasks. Theoretical preparedness for laboratory work, the quality of report writing, and the ability to summarize and interpret the obtained results.
Exam	50	During exam session	The accuracy and comprehensiveness of responses to the course's theoretical questions, together with the ability to complete a practical task.

Author	Publishing year	Title	Issue of a periodical or volume of a publication; pages	Publishing house or internet site
Required reading				
Yik Yang	2014	LabVIEW graphical programming cookbook : 69 recipes to help you build, debug, and deploy modular applications using LabVIEW		Packt Publishing ISBN: 9781782171409
A. Gurskas	2010	Virtualieji instrumentai LabVIEW terpėje		VGTU leidykla
Ed. J. G. Webster	1999	Measurement, Instrumentation & Sensors		CRC Press LLC
Measurement Computing	2012	Data acquisition handbook. A reference for DAQ and		Measurement Computing

Corporation		analog & digital signal conditioning		Corporation
Ed. Walt Kester	2004	Analog-Digital Conversion		Analog Devices
Recommended reading				
Steven W. Smith	1999	The Scientist and Engineer's Guide to Digital Signal Processing		California Technical Publishing
Measurement Computing Corporation	2013	Data Acquisition Fundamentals: Improving Measurement Quality with Signal Conditioning		Measurement Computing Corporation
Walt Kester	2005	Which ADC Architecture Is Right for Your Application?	Analog Dialogue 39-06, June	Analog Device
Bob Judd	2010	Everything You Ever Wanted to Know about Data Acquisition		United Electronic Industries