COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Linux Embedded Systems Applications	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: assoc. prof. Vilma Kavaliukė **Other(s):**	VU Faculty of Physics

Study cycle	Type of the course unit (module)
second	compulsory

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
face-to-face	1 semester	English

Requirements for students	
Prerequisites: "Introduction to Programming", "Electronics", "Introduction to Microcontrollers"	**Additional requirements (if any):**

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	140	64	76

Purpose of the course unit (module): programme competences to be developed		
Aim: To provide knowledge about single-board computers progress trends, application area of single-board computers. After completing the course, students will be able adapt single-board computers for experimental data processing, automation systems, image recognition and smart systems.		
Learning outcomes of the course unit (module)	**Teaching and learning methods**	**Assessment methods**
Students will know single-board computers progress trends. Students will receive knowledge about installing and configuring drivers on a single-board computer.	Lecture, reading of literature, discussion during laboratory work.	Exam
Students will be able to program Python language. They will be able to write software for a single-board computer to collect and transfer data to a communication channel. Students will be able to adapt a single-board computer for system automation, video recognition and intelligent systems development.	Electronic circuit diagram analysis, demo board programming, program debugging and testing.	Demonstration of program operation, explanation of program operation.

Content: breakdown of the topics	Contact hours	Self-study work: time and assignments

	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work placement	**Contact hours**	**Self-study hours**	**Assignments**
1. **Introduction.** Single-board computer architecture, development trends, technical characteristics and applications. Single-board computer operating systems.	4						**4**	**8**	Read the literature on the specified topics
2. **Single-board computer software**. Operational systems in single-board computers. Linux distributions for single-board computers. Programming languages, compiling and launching the program on a single-board computer. Installation of external packages.	4				4		**8**	**16**	Read the literature on the specified topics.
3. **Python programming language.** Python language syntax: variables, functions, loops. Use of additional Python libraries, parallel programming of processes.	8				8		**16**	**16**	Write programs for single-board computer.
4. **Single-board computers peripherals.** Analogue-to-digital converters; GPIO outputs; usage and application examples of UART, I2C, SPI interfaces Linux libraries for peripherals of single-board computer. Ethernet interface and TCP / IP protocols on a single-board computer.	8				8		**16**	**16**	Write programs for single-board computer.
5. **Image processing and recognition.** Camera drivers for single-board computer. Image recognition principles and areas of use. OpenCV library: overview, principles of use and applications.	8				12		**20**	**20**	Write programs for single-board computer.
Total	**32**				**32**		**64**	**76**	

Assessment strategy	**Weigh t,%**	**Deadline**	**Assessment criteria**
Write a program for single-board computer and answer to questions.	40	by the end of the semester	5-6 points: the ability to write, test and demonstrate program. 7-8 points: the ability to explain the logic of the operation of the program, reasoning in answering questions. 9-10 points: ability to explain alternative ways of programming the problem, ability to think reasonably in response to problematic issues.
Test No. 1	30	during the semester	Test of 10 questions.
Test No. 2	30	during the semester	Test of 10 questions.
Exam (instead of tests)	60	session	Test of 20 questions. Students may replace the final exam with two mid-semester tests. Nevertheless, successful completion of all laboratory assignments is required for the final assessment.

Author	**Year of public ation**	**Title**	**Issue of a periodical or volume of a publication**	**Publishing place and house or web link**
Compulsary reading				
P. Raghavan, Amol Lad, Sriram Neelakandan	2005	Embedded Linux System Design and Development		Auerbach Publications
Zed Shaw	2013	Learn Python the Hard Way		Addison-Wesley
Joseph Howse	2013	OpenCV Computer Vision with Python		PACKT

Derek Molloy	2016	Exploring Raspberry Pi. Interfacing to the real world with embedded Linux		WILEY
Optional reading				
Dogan Ibrahim	2020	Multitasking with Raspberry Pi		Elektor Publication
Dennis L. Eggleston	2011	Basic electronics for scientists and engineers		Cambridge University Press