Specification for the book of courses

Study program	Electrical Engineering and Computer Science		
Module	Electronics - Electronic Circuits and Embedded Systems		
Type and level of studies	Undergraduate Academic Studies		
The name of the course	Virtual Instruments		
Lecturer (for lectures)	Dimitrijević A. Marko		
Lecturer/associate (for exercises)	Dimitrijević A. Marko		
Lecturer/associate (for OFE)	Dimitrijević A. Marko		
Number of ECTS	5	**Course status (obligatory/elective)**	Elective
Prerequisites			
Course objectives	Introduction to the concept of virtual instrumentation, data-flow data processing and realization of systems for measuring, analyzing and visualizing signals on the computer.		
Course outcomes	Mastering implementation of systems for measuring, analyzing and visualizing signals (virtual instruments) using LabVIEW development environment. Students will gain the ability to develop virtual instruments on different platforms and perform measurement, analysis and visualization of signals.		
Course outline			
Theoretical teaching	The concept of a virtual instrument, the advantages of virtual instruments over classic instruments. Basic concepts of data acquisition - resolution, sampling rate, A/D conversion. Virtual instrument hardware and software. The concept of data-flow data processing and graphic programming. Analysis of data obtained, documentation and visualization. Advanced programming techniques - event-driven model, producer-consumer, finite state machine, error control, multithread applications, synchronization of processes and threads, object-oriented approach. Virtual instruments for measuring and analyzing signals in real-time. Signal analysis on FPGA. Distributed virtual instruments and SCADA.		
Practical teaching (exercises, OFE, study and research work)	Introduction to the LabVIEW development environment (front panel, block diagram, palette with elements), implementation of virtual instruments in LabVIEW environment. Data-flow programming and modular programming. Loops. Arrays, work with files, waveforms (Waveform Graphs). Strings, clusters, error control, case structures and sequence structures. Data acquisition in the LabVIEW environment. Documenting measurement results. Network connections and data transfer. Basic software architectures - realization of event-driven and error control virtual instrument, finite state machine, multithread applications, synchronization of processes and threads. Integration of heterogeneous code and components (IP blocks, DLL, .NET and ActiveX). Porting virtual instruments to a real-time working environment. Virtual instrument implementation on FPGA. Object oriented approach. Distributed virtual instruments with a client-server model. Implementation of SCADA system.		
Textbooks/references			
1	C. L. Clark, "LabVIEW Digital Signal Processing and Digital Communications", McGraw-Hill, 2010		
2	R. Bitter, T. Mohiuddin, M. Nawrocki, LabVIEW™ "Advanced Programming Techniques, Taylor & Francis", 2007		
3	M. Dimitrijević, Signal measurement, analysis and visualization using LabVIEW, (in Serbian), script		
4			
5			

Number of classes of active education per week during semester/trimester/year

Lectures	Exercises	OFE	Study and research work	Other classes
2	1	1	0	0
Teaching methods	Lectures, exercises, laboratory work, consultations, project			

Grade (maximum number of points 100)

Pre-exam duties	Points	Final exam	Points
Activity during lectures	10	**Written exam**	
Exercises	20	**Oral exam**	70
Colloquia			
Projects			