Specification for the book of courses

Study program	Electrical Engineering and Computer Science		
Module	Common		
Type and level of studies	Doctoral studies		
The name of the course	Reliability of Electronic Devices and Microsystems		
Lecturer (for lectures)	Davidović S. Vojkan		
Lecturer/associate (for exercises)			
Lecturer/associate (for OFE)			
Number of ECTS	10	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	The objective of the course is to master knowledge in the field of reliability (Reliability function, time to failure, mean time between failures, distribution functions: exponential, Weibull, normal, gamma distribution), mastering knowledge of failure physics and diagnostics of various components that are part of the microsystem (semiconductor devices, printed circuit boards, capacitors, coils, batteries, transmitters-receivers), as well as acquiring the knowledge necessary to form a model of reliability of the microsystems and use of software tools in modeling. Also, the objective of the course is to familiarize with existing standards and laboratory methods for accelerated testing (HALT, HASS, BURN-IN, thermal cycling, vibration), and calculation of the reliability of microsystems based on specific tests performed on individual components.
Course outcomes	The student has knowledge from the basic theory of reliability, understands the reliability function and failure rate, understands several different distribution functions in that scope so that he can mathematically successfully process them, or perform the necessary calculations. He knows what are the possible forms and causes of failure in the constituent elements of the microsystem, he knows mechanisms and models for accelerating the failure in the operation at elevated temperature, voltage, humidity, radiation, electrostatic discharge, vibration, mechanical and simultaneous stress. He possesses the necessary knowledge of the tests for certain components, the laboratory equipment for their implementation. He is familiar with contemporary scientific achievements in the field and relevant scientific publications. He can form a model of reliability of the microsystem, to use software tools, and to perform reliability calculations.
Course outline	
Theoretical teaching	Elements of reliability theory. Failure, mechanisms, and cause of failure. Reliability function, failure rate, bathtub curve, mean time to failure, mean time between failures, distribution functions (exponential, Weibull, normal, gamma distribution). Degradation and failure of microelectronic devices (defects in the substrate, defects in oxide, breakdown of dielectrics, failures at contacts and metallization, case and terminals). Overstress induced failures (elevated temperature, humidity, electric field, ionizing radiation, electrostatic discharge, mechanical stress and vibration). Reliability and failures in multilayer printed circuits boards, capacitors, coils, lithium-ion batteries, transceiver modules, MEMS components, solar modules. Failure diagnostics, microscopy and electrical testing. Accelerated reliability testing - appropriate tests and equipment, acceleration factor for individual tests. MIL-STD and IEC standards. Analysis of the time to failure. Chi-square test. Application of the Weibull + software package for reliability modeling.
Practical teaching (exercises, OFE, study and research	EXERCISES: Classical tasks based on practical examples, calculation of reliability and hazard function, time to failure. LABORATORY: Accelerated testing of several components (microsystem elements) under harsh conditions (elevated temperature, polarization or radiation). Analysis of results and modeling. CONSULTATIONS: Obtaining results and analysis of relevant scientific publications.
Textbooks/references	
1	F. Jensen, Electronic Component Reliability, John Wiley, 1995
2	J. W. McPherson, Reliability Physics and Engineering (Time-To-Failure Modeling), Springer, 2010, ISBN 978-1-4419-6347-5
3	Elsayed A. Elsayed, Reliability Engineering (2nd edition), John Willey & Sons, 2012, ISBN 978-1-118-13719-2

4	Lawrence M. Leemis, RELIABILITY - Probabilistic Models and Statistical Methods,(2nd edition), 2009, ISBN 978-0-692-00027-4			
5	Microelectronics Reliability, Elsevier, selection of appropriate scientific papers in the field			
Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
3	0	0	0	0
Teaching methods	Lectures, consultations, computational exercises and task processing from practical examples, analysis of presentations and scientific publications, laboratory work, consultations in the form of mentoring in the processing of results.			
Grade (maximum number of points 100)				
Pre-exam duties		**Points**	**Final exam**	**Points**
Activity during lectures		20	**Written exam**	20
Exercises		20	**Oral exam**	20
Colloquia		10		
Projects		10		