Specification for the book of courses

Study program	Electronics and Microsystems		
Module	Electronics and Microsystems		
Type and level of studies	Master studies		
The name of the course	Nanoelectronics		
Lecturer (for lectures)	Davidović S. Vojkan, Golubović M. Snežana		
Lecturer/associate (for exercises)	Davidović S. Vojkan		
Lecturer/associate (for OFE)			
Number of ECTS	5	**Course status (obligatory/elective)**	Elective

Prerequisites	
Course objectives	The objective of the course is providing the students with the necessary level of knowledge oncurrent trends in the field of the latest nanoelectronic devices and systems, their development, new principles of device operation, advanced materials used for realization of nano-devices, technological processes that implement the nano-devicess and models describing their operatin. By acquiring knowledge in this subject, a student should be able to easyer fit in with modern semiconductor industry and understand new achievements in the field of information technology.
Course outcomes	The student is familiar with scaling rules and trends in the development of nanodevices. He knows the specificities of technological processes for the realization of very thin and well-controlled layers of materials, material removal techniques and adequate measuring methods. He understands the application of high-k dielectric materials, strained silicon, metal gates, understands the structure and operation of the FD and SOI transistors, as well as FinFET model. He understands the ferroelectric FET, the principle of RTD and Single electron transistors. He understands the superconductivity and its application in electronics, the potentials of carbon nanotubes for the realization of devices, devices based on organic molecules, memory components for RAM or HDD and sensor devices. In general, his thinking is shifted from the macrolevel to the level of very thin layers, the interaction of a small number of molecules, the significance of the interface phenomena and new materials.
Course outline	
Theoretical teaching	Scaling theory, Moore law. Materials in nanoelectronics (semiconductors, dielectrics, ferroelectrics, organic molecules). Quantum effects - tunneling. Technological methods of thin layers of material deposition. Lithography. Materials removal techniques - etching and chemo-mechanical polishing. Measuring techniques in nanotechnology. Silicon MOSFET transistors - new materials and alternative concepts (high-k dielectrics, strained silicon). FinFETs, structures and modeling. Ferroelectric FET transistors. Resonant tunneling devices. Single-electron transistors. Superconducting electronics. Quantum computing based on a superconductors. Graphene and carbon nanotubes and devices. Nanoelectronic devices based on organic molecules. Nanoelectronic RAM. Ferroelectric RAM devices. The concept of high density memory disks - AFM. Sensor nanodevices.
Practical teaching (exercises, OFE, study and research	Defining and solving a certain number of tasks related to physical phenomena and the operating of nanoelectronic devices, modeling and computer simulation. In the form of consultations, a number of scientific papers (selected in accordance to the affinity of the student himself) in the field of nanoelectronic devices will be analyzed.
Textbooks/references	
1	Rainer Waser (Ed.), NANOELECTRONICS AND INFORMATION TECHNOLOGY, Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003, ISBN 3-527-40363-9
2	Brajesh Kumar Kaushik, NANOELECTRONICS, Devices, Circuits and Systems, Elsevier, 2018, ISBN 9780128133538
3	K. Goel, NANOELECTRONICS AND NANOSYSTEMS, From Transistors to Molecular Quantum Devices, Springer 2004, ISBN 978-3-662-05421-5
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Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**

2	2	0		
Teaching methods	Lectures using PowerPoint presentations, problem solving, consulting classes.			
Grade (maximum number of points 100)				
Pre-exam duties		**Points**	**Final exam**	**Points**
Activity during lectures		20	**Written exam**	20
Exercises			**Oral exam**	30
Colloquia		10		
Projects		20		