GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Microelectromechanical Systems, PG_00048580		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	February 2024	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Microelectronic Systems -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Piotr Płotka	
	Teachers	dr hab. inż. Piotr Płotka	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	15.0	30

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	4.0	16.0	50

Subject objectives

Introduction to MEMS technologies, presentation of recent developments in MEMS, as well as teachig of application of tools used for simulating of electronic circuits for designing of MEMS.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U06] can analyse the operation of components, circuits and systems related to the field of study; measure their parameters; examine technical specifications; interpret obtained results and draw conclusions	knowing the theoretical methods developed for analysis of electronic circuits and electro-mechanical analogies, applies them for analyses of systems containing mechanical as well as electronic elements	[SU1] Assessment of task fulfilment
[K7_U02] can perform tasks related to the field of study as well as formulate and solve problems applying recent knowledge of physics and other areas of science	is able to study necessary topics in physics and chemistry and apply the gained knowledge for modelling of operation of MEMS elements which he/she did not know earlier	[SU1] Assessment of task fulfilment
[K7_U07] can apply advanced methods of process and function support, specific to the field of study	is able to apply creatively computer aided design tools developed for electrical circuits in order to design complex electromechanical systems	[SU1] Assessment of task fulfilment
[K7_W03] Knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum.	knows and understands construction and operation mechanisms of basic MEMS elements representative for applications in various fields	[SW1] Assessment of factual knowledge
[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	knows and understands methods used for simulation tools for electronic circuits, which are useful also in MEMS design	[SW1] Assessment of factual knowledge

Subject contents	1.Introduction. Evolution of microelectromechanical systems and markets. 2. MEMS fabrication and materials - patterning, etching, deposition and stress control. 3. MEMS fabrication and materials - bonding, heterogeneous integration, packaging and mechanical property. 4. Review of MEMS elements and their fabrication – sensors. 5. Review of MEMS elements and their fabrication – actuators, energy sources. 6. Applications of MEMS - automobile & home, information processing & telecommunication 7. Applications of MEMS – biomedical & chemical 8. Application of electronic circuits simulators for electromechanical simulations: current – force analogy 9. Application of electronic circuits simulators for electromechanical simulations: voltage – force analogy 10. Design of mechanical elements – beams and springs 11. Design of mechanical MEMS elements with beams and springs 12. Design of mechanical MEMS elements with mechanical resonance 13. Design of MEMS elements for electronic applications at radio frequencies. 14. Design of MEMS elements with piezo-elements. 15. Integration of MEMS and electronic circuits
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm colloquium	50.0%	50.0%
Practical exercises	50.0%	50.0%

Recommended reading	Basic literature	W. K. Schomburg, Introduction to Microsystem Design, Springer 2011 V.K. Varadan, K.J. Vinoy, K. A. Jose, U. Zoelzer, RF Mems & Their Applications, Wiley 2002 M. Esashi, Premium Tutorial, The 11th. Annual IEEE Int. Conf. on Nano/ Micro Engineered and Molecular Systems (IEEE-NEMS 2016), Matsushima and Sendai, Japan, 17-20 April, 2016

	Supplementary literature	T. M. Adams, R. A. Layton, Introductory MEMS. Fabrication and Applications, Springer 2010 B. Bhushan (ed.), "Springer Handbook of Nanotechnology", Springer-Verlag, 2004. H. J. de Los Santos, RF MEMS Circuit Design for Wireless Communications, Artech 2002 N. Maluf, K. Williams, An Introduction to Microelectromechanical Systems Engineering, 2 ed., Artech 2004 S. Carrara, "Bio/CMOS Interfaces and Co-Design", Springer 2013
	eResources addresses	Adresy na platformie eNauczanie: Systemy Mikroelektromechaniczne MEMS - 2024 - Moodle ID: 32180 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32180
Example issues/ example questions/ tasks being completed	Silicon micromachining: surface and bulk. Proces LIGA. MEMS and nanotechnology in massive data storage systems. Bio- and chemical sensors and actuators. Nano- i MEMS technology in optoelectronics. Shape memory alloys in MEMS technology. Using of MEMS technology in making tunable capacitors. Silicon micromotors.	
Work placement	Not applicable	