



Subject card

Subject name and code	Microelectromechanical Systems, PG_00064021						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	February 2026		Academic year of realisation of subject		2025/2026		
Education level	second-cycle studies		Subject group		Optional subject group Specialty 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 -> Wydziały Politechniki Gdańskiej						
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	15.0	0.0	0.0	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_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_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 apply his already gained knowledge in physics and chemistry for modelling of operation of MEMS elements which he/she did not know earlier		[SU1] Assessment of task fulfilment		
	[K7_W10] knows and understands, to an increased extent, the basic processes occurring in the life cycle of equipment, objects and technical systems, as well as methods of supporting processes and functions, specific to the field of study		Recognizes and understands possibilities of application of MEMS modules for designing of save, efficient and automated systems and processes.		[SW1] Assessment of factual knowledge		

Subject contents	<p>Lectures:</p> <p>1.Introduction. Evolution of microelectromechanical systems and markets.</p> <p>2. MEMS fabrication and materials - patterning, etching, deposition and stress control.</p> <p>3. MEMS fabrication and materials - bonding, heterogeneous integration, packaging and mechanical property.</p> <p>4. Review of MEMS elements and their fabrication sensors.</p> <p>5. Review of MEMS elements and their fabrication actuators, energy sources.</p> <p>6. Applications of MEMS - automobile & home, information processing & telecommunication</p> <p>7. Applications of MEMS biomedical & chemical</p> <p>8. Application of electronic circuits simulators for electromechanical simulations: current force analogy</p> <p>9. Application of electronic circuits simulators for electromechanical simulations: voltage force analogy</p> <p>10. Design of mechanical elements beams and springs</p> <p>11. Design of mechanical MEMS elements with beams and springs</p> <p>12. Design of mechanical MEMS elements with mechanical resonance</p> <p>13. Design of MEMS elements for electronic applications at radio frequencies.</p> <p>14. Design of MEMS elements with piezo-elements.</p> <p>15. Integration of MEMS and electronic circuits.</p> <p>Lab:</p> <p>Investigation of a beam type model of a MEMS resonator with capacitive coupling</p> <p>Applications of accelerometers in a wing model</p> <p>Applications of pressure sensors in a wing model</p> <p>Investigation of MEMS accelerometers, inclinometers and gyroscopes</p> <p>Frequency stabilization with MEMS resonators</p>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Practical exercises	50.0%	50.0%
	Midterm colloquium	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:	
Example issues/ example questions/ tasks being completed	Silicon micromachining: surface and bulk. Process LIGA. Bio- and chemical sensors and actuators. Nano- and micro- MEMS technology in optoelectronics. Using of MEMS technology in making tunable capacitors. Silicon micromotors. Selection of design parameters and electromechanical testing of a beam-type resonator with a capacitive coupling.		
Work placement	Not applicable		

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