GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modern Trends in Microelectronics, PG_00064031		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2026/2027
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	2	ECTS credits	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Piotr Płotka	
	Teachers	dr hab. inż. Piotr Płotka	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	0.0	0.0	15.0	15

E-learning hours included: 0.0

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=1396

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	15	2.0	8.0	25

Subject objectives

The goal is to develop students' skills in using newly published professional review literature, including review articles from important international conferences, to create a picture of the current state of art in a selected engineering topic, as well as to determine the most likely directions of development of technological solutions in this area for the next few years. This goal is achieved by using the current trends in the design and technology of advanced integrated circuits as an example. The goal is also to develop the ability to communicate this picture to a group of engineering professionals working on similar topics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U10] can individually plan and pursuit their own lifelong education and influence others in this aspect, also by means of advanced information and communication technologies (ICT), and communicate on specialist issues with diverse recipients, appropriately justify points of view, hold debates, present, assess and discuss different opinions and points of view, as well as use specialist terminology related to the field of study in communication	Based on available technical review literature, the student can develop an understanding of the current state of art in a selected area of design or technology of advanced integrated circuits. This information should also provide him an insight into the likely progress in this area over the next few years. He should be able to convince a group of students with similar educational and professional experience to his conclusions.	[SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task
[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	Based on available technical review literature, the student is able to develop an understanding of the conditions necessary to achieve the progress in the development of a given group of technical solutions - those presented in the literature, as well as those predicted by himself. He is also able to assess objectively the real importance of solutions presented in the literature.	[SK5] Assessment of ability to solve problems that arise in practice

Subject contents	Course content – seminar The topics prepared by students will change from year to year to keep pace with progress in microelectronics technology. In the 2025/2026 academic year, students worked on the topics listed below. The mandatory basis for the presentation is a review article proposed or approved by the instructor. Students prepare two presentations. The first presentation presents the topic of the paper. The second presentation expands on the topic by drawing on additional publications, the list of which requires instructor approval. 2026/2027 Topics: 01. Prospects of data processing in memory 02. Prospects of computing in or near flash memories 03. CMOS integrated circuits of 3D construction - Samsung 04. Vertical integration of pMOS and nMOS TSMC 05. CMOS scaling for 5 nm and beyond 06. CMOS brain interface 07. Design and applications of integrated transducers in commercial CMOS Technology 08. IEDM2024 history and future of integrated circuits 09. Assembling chips of integrated circuits 10. Skin-inspired bioelectronic sensors 11. Field effect transistor with modulation-doped SiGe channel 12. TSMC - silicon photonics platform for data communication 13. Prospects of integrated circuits scaling with attention at silicon and 2D semiconductors 14. Expected progress of integrated circuits fabricated in 2D semiconductors 15. Field effect transistors fabricated with carbon nanotubes 16. Integrated circuits for piezoelectric energy harvesters 17. Integration of GaN power devices
Prerequisites and co-requisites	Prerequisites depend on the student's field of study. Students majoring in Electronics should go deeper into the subject matter, while the students in other fields, considering the subject as a supplementary course, should acquire more general knowledge and skills. Therefore, for the students in Electronics, the prerequisites are the knowledge on electronic elements, on fundamentals of microelectronics, and on basics of integrated circuit design. Students in other fields may have less detailed knowledge on these topics.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Evaluation of the presentation by the teacher and the audience	50.0%	60.0%
Assessment of student participation in the discussion	50.0%	20.0%
Assessment of the test of knowledge on all presented topics	50.0%	20.0%

Recommended reading	Basic literature	1. Kaur, R, Asad, A; Mohammadi, F, A Comprehensive Review of Processing-in-Memory Architectures for Deep Neural Networks, COMPUTERS, vol. 13 (7), 174, JUL 2024; DOI 10.3390/computers13070174; 2. H. -T. Lue, C. -H. Hung, K. -C. Wang and C. -Y. Lu, "Prospects of Computing in or Near Flash Memories," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10873502; 3. Juhun Park, Jaehyun Park, et.al., Realization of CMOS operation in 3-dimensional stacked FET with self-aligned direct backside contact, Japanese Journal of Applied Physics, vol. 63, Number 12, 120803, 2024; ; DOI 10.35848/1347-4065/ad8fb5 4. S. Liao et al., "First Demonstration of Monolithic CFET Inverter at 48nm Gate Pitch Toward Future Logic Technology Scaling," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10873334; 5. Radamson, HH; Miao, YH; et al, CMOS Scaling for the 5 nm Node and Beyond: Device, Process and Technology, Nanomaterials 2024, 14(10), 837; https://doi.org/10.3390/nano14100837; 6. B. Dutta et al., "Neuropixels Probe: A 130nm/55nm CMOS-Based Integrated Multimodal Microsystems Technology Platform for Large Scale Brain Wide Recording," 2024 IEEE International Electron Devices Meeting (IEDM), San 7. Rawat, U, Anderson, JD, Weinstein, D, Design and Applications of Integrated Transducers in Commercial CMOS Technology, FRONTIERS IN MECHANICAL ENGINEERING-SWITZERLAND, v8, 902421, 2022, DOI: 10.3389/fmech.2022.902421; 8. Barriers and Forging Ahead," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10872992; A. Aleksov, G. C. Dogiamis, A. Elsherbini and J. Swan, "Tomorrow's Modular & Scalable Compute Systems," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10873585; Tomorrows Modular amp Scalable Compute Systems IEDM 20 9. S. Arkalgud et al., "Implications of Wafer Bonding for Advanced Logic Technology Development," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10873321; 10. C. Wu, W. Wang, D. Zhong and Z. Bao, "Skin-Inspired Sensors and Integrated Circuits for Wearables and Implantables (Invited)," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10873409; 11. S. K. Yeh et al., "Silicon Photonics Platform for Next Generation Data Communication Technologies," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10873369; 12. Mohamed Morsy, Faycal Znid, Abdallah Farraj, A critical review on improving and moving beyond the 2 nm horizon: Future directions and impacts in next-generation integrated circuit technologies, Materials Science in Semiconductor Processing, Volume 190, 2025, 109376, https://doi.org/10.1016/j.mssp.2025.109376; 13. Lei Yin, Ruiqing Cheng, Jiahui Ding, Jian Jiang, Yutang Hou, Xiaoqiang Feng, Yao Wen, and Jun He, Two-Dimensional Semiconductors and Transistors for Future Integrated Circuits, ACS Nano 2024 v18 (11), 7739-7768; DOI: 10.1021/acsnano.3c10900; 14. Y.-F. Liu et al., "High-Performance Aligned Carbon Nanotube FETs with Record Transconductance of 3.7 mS/μm," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10873592; 15. Di Li, Chun Wang, Xinhui Cui, Dongdong Chen, Chunlong Fei, Yintang Yang, Recent progress and development of interface integrated circuits for piezoelectric energy harvesting, Nano Energy, vol. 94, 106938, 2022, https://doi.org/10.1016/j.nanoen.2022.106938; 16. F. Udrea, "Combo ICeGaN: The Combination of a Smart GaN HEMT and an IGBT," 2024 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2024, pp. 1-4, doi: 10.1109/IEDM50854.2024.10873403;
	Supplementary literature	to be approved by the instructor
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. What logical operations can be performed in dynamic random-access memory integrated circuits? 2. Should we expect the development of graphene integrated circuits? Justify your answer. 3. What transducers can be integrated with previously fabricated CMOS integrated circuits? 4. Name the fundamental limitations to further scaling of CMOS circuits.	
Practical activites within the subject	Not applicable	

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