PhD STUDIES COURSE UNIT DESCRIPTION

Name of subject	Field of science, code	Faculty / Center	Department
Microbial fuel cells	Chemistry N 003	Center for Physical Sciences and Technology	Department of Chemical Engineering and Technology
Student's workload	**Credits**	**Student's workload**	**Credits**
Lectures		Consultations	
Independent study	10	Seminars	

Course annotation
Overview of microbial biofuel cells. Energy and the challenge of global climate change. Generation of "bio-electricity" using microbial fuel cells. Microbial biofuel cells for wastewater treatment technologies. Renewable energy production using microbial biofuel cells. Exoelectrogens. Electron transfer mechanisms. Investigations of microbial biofuel cells using known exoelectogenic strains. Voltage based on thermodynamic relations. Anode potential and enzyme potential. The role of exoelectrogens and enzymes in determining anode potential. Power generation. Energy efficiency. Polarization and power density curves. Measurement of internal resistance. Chemical and electrochemical analysis of reactors. Materials. Search for cheap, highly effective materials. Anodic materials. Membranes and separators (and chemical transport through them). Cathodic materials. Long-term stability of various materials. Design. Air cathode MFC. Aqueous cathodes using dissolved oxygen. Two - chamber reactors with soluble catholytes or certain potentials. Kinetics and mass transfer. Kinetics and mass transfer models. Maximum power of one layer of bacteria. Maximum mass transfer rate from the "biofilm". Mass transfer per reactor volume. Microbial fuel cells for wastewater treatment. Replacement of biological treatment reactor. Energy balances for wastewater treatment plants. Effect on sludge reduction. Nutrient removal. Electrogenesis and methanogenesis.
Reading list
1. Keith Scott and Eileen Hao Yu. Microbial Electrochemical and Fuel Cells Fundamentals and Applications. Elsevier, 2016. 2. Bruce E. Logan. Microbial Fuel Cells. John Wiley & Sons, 2008. 3. Debabrata Das. Microbial Fuel Cell: A Bioelectrochemical System that Converts Waste to Watts. Springer International Publishing, 2018. 4. Venkataraman Sivasankar, Prabhakaran Mylsamy, Kiyoshi Omine. Microbial Fuel Cell Technology for Bioelectricity. Springer International Publishing, 2018.

The names of consulting teachers	**Science degree**	**Main scientific works published in a scientific field in last 5 year period**
Inga Morkvėnaitė-Vilkončienė	Dr.	Rozene, J.; Morkvenaite-Vilkonciene, I.; Bruzaite, I.; Dzedzickis, A.; Ramanavicius, A. Yeast-Based Microbial Biofuel Cell Mediated by 9,10-Phenantrenequinone. Electrochim. Acta 2021, 373, 137918. Rozene, J.; Morkvenaite-Vilkonciene, I.; Bruzaite, I.; Zinovicius, A.; Ramanavicius, A. Baker's Yeast-Based Microbial Fuel Cell Mediated by 2-Methyl-1,4-Naphthoquinone. Membranes (Basel). 2021, 11 (3), 1–10. Bruzaite, I.; Rozene, J.; Morkvenaite-Vilkonciene, I.; Ramanavicius, A. Towards Microorganism-Based Biofuel Cells: The Viability of Saccharomyces Cerevisiae Modified by Multiwalled Carbon Nanotubes. Nanomaterials 2020, 10 (5), 1–14.
Arūnas Ramanavičius	Habil. Dr.	Andriukonis, E., Celiesiute-Germaniene, R., Ramanavicius, S., Viter, R., & Ramanavicius, A. (2021). From microorganism-based amperometric biosensors towards microbial fuel cells. Sensors, 21(7), 2442. Kisieliute, A.; Popov, A.; Apetrei, R.-M.; Cârâc, G.;

		Morkvenaite-Vilkonciene, I.; Ramanaviciene, A.; Ramanavicius, A. Towards Microbial Biofuel Cells: Improvement of Charge Transfer by Self-Modification of Microoganisms with Conducting Polymer – Polypyrrole. Chem. Eng. J. 2019, 356, 1014–1021.

Certified during Doctoral Committee session on September 28th, 2021. Protocol No. 610000-KT-142.
Committee Chairman prof. habil. dr. Aivaras Kareiva