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| **Title and Code** of the subject:  **Biosensors and nanotechnology MTMEL7032A** | **ECTS Credit Points: 4** |
| **Type** of the subject: compulsory | |
| **Ratio of theory and practice: 50/50** (credit%) | |
| **Type and number of classes per semester**: 28 hour(s) lecture and 14 hour(s) practice per **semester**  Number of teaching hours / week: 2+2 (lecture and practice) | |
| **Type of exam**: written or oral exam | |
| **Subject in the curriculum:** semester 2 | |
| Preliminary requirements:- | |

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| **Summary of content - theory**: |
| 1. The operating principle and application areas of various chemical sensors. (Macro and Micro Sensors). 2. Electrochemical sensors: potentiometric, conductometric, amperometric. Optical sensors. Piezoelectric sensors. Thermal sensors. 3. Biosensors and their application. (Macro and Micro Sensors). The physicochemical, biochemical and technological basis of biosensors. Metabolizmusszenzorok. Affinitásszenzorok. Biosensors in Clinical Chemistry Laboratory: Practical Applications. Use of biocompatible materials. 4. Immun analytical methods. Sensors produced by technologies used in the microelectronics industry. The concept, the distribution, the characteristics of sensors, intelligent and integrated sensors, novel requirements. Special types of materials and technologies. 5. Instrument Structures in Sensors: Impedance Structures, Semiconductor Devices, Electrochemical Cells, Calorimetric Resonators, and Fiber Optic Types. 6. The basic properties of the transformation are: - the effects of temperature: thermoresistive and thermoelectric, piroelectric effect - mechanical stress and deformation effects: piezoelectric, piezoresistive effect, capacity change, electrets - effects of the magnetic field: charge rejection Hall effect, magnetoresistive effect, superconductivity - effects of radiation: thermal and quantum effects. 7. Molecular interactions of chemical transformation: adsorption, absorption, ion exchange, the possibilities of chemical optical transformation, the basics of bio sensors. 8. Physical sensors and their applications in medical biology: temperature measurement, other applications of temperature sensors, applications of mechanical sensors, ultrasonic sensors in echography, nuclear detectors in radiology, applications of magnetic sensors, flow measurement. Chemical sensors and their applications in medical biology: blood gas concentrations and pH sensors (invasive and transcutaneous 9. Electrochemical sensors, fiber optic sensors, combined types), oximetry, ion selective sensors, pH measurement in the digestive tract, determination and mapping of tissue pH / pO2. Bio sensors: enzymatic or Biocatalytic sensors (principles, glucose sensors, additional biocatalytic sensors, affinity bio sensors (immunoassays, DNA chips), live biosensors. 10. Fundamentals of nanotechnology. Mitigation and new phenomena, properties, techniques. 11. The tools of nanotechnology I. Classical (optical and electron) microscopy. 12. Scan scanning microscopy. Scanning Tunnel Microscope (STM), Nuclear Power Microscope (AFM). Atomic level solving and manipulation. III. Electron and ion beam machining. 13. Materials of nanotechnology, metal nanoparticles, carbon nanostructures, biotechnology methods for producing nanoscale particles. 14. Applications. Micro and nanoactivators, micro and nanofluidic devices. Applications: optical systems, lab-on-chip concept. |
| **Summary of content - practice**: |
| 1. Arduino and sensors (4 hours) 2. Programming of Arduino (4 hours) 3. Testing of sensors 1: teperature (2 hours) 4. Testing of sensors 1: pressure (2 hours) 5. Testing of sensors 1: weight (2 hours) 6. Testing of sensors 1: water activity (2 hours) 7. Producing of selenium nanoparticles with chemical method (4 hours) 8. Progucing of selenium nanoparticles by biotechnology (4 hours) 9. Testing of toxicity of nanoparticles (4 hours) |
| **Literature, handbooks in English** |
| 1. Biosensors: Theory and Applications Donald G. Buerk 1995 by CRC Press ISBN 9780877629757 2. Chemical Sensors and Biosensors: Fundamentals and Applications Florinel-Gabriel Bănică ISBN: 9780470710661 2012 John Wiley & Sons, Ltd 3. Electrochemical Sensors, Biosensors and their Biomedical Applications Xueji Zhang, Huangxian Ju and Joseph Wang ISBN: 978-0-12-373738-0 2008 Elsevier Inc 4. Textbook of Nanoscience and Nanotechnology B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday ISBN: 978-3-642-28029-0 |
| **Competencies gained** *(acc. to the Regulation on training and outcome requirements)* |
| 1. **Knowledge:**  * The student has a good understanding of the basics of biosensors and nanotechnology.  1. **Skills:**  * The student identifies specific problems in the sensor technology and its connection to nanotechnology.  1. **Attitude:**  * Committed to his profession, he knows and undertakes its core values and norms, strives to critically interpret and develop them, and solve problems on a professional basis. * The student recognizes values in the field of biosensors.  1. **Autonomy and responsibility:** |

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| **Responsible lecturer: Dr. Prokisch József** |
| **Other lecturer(s): -** |

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| **Terms of course completion:** |
| Practical test |
| **Form of examination:** |
| Practical test |
| **Requirement(s) to get signature:** |
| taking part of 60% of practice |

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| **Exam questions:** |
| Making a system with sensor and display with arduino for solving a practical problem. |