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| **Title** and code of the subject:  **Analytical and microbiological rapid methods, MTMEL7020A** | **ECTS Credit Points: 4** |
| **Type** of the subject: compulsory / optional | |
| **Ratio of theory and practice:** 50/50(credit%) | |
| **Type and number of classes per semester**: 28 hour(s) lecture and 28 hour(s) seminar per **semester** | |
| **Type of exam**: exam / practical course mark | |
| **Subject in the curriculum:** semester 4 | |
| Preliminary requirements:Basics of food microbiology, Basics of cellular and molecular biology, Nutritional sciences | |

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| **Summary of content - theory**: |
| Modern methods of food analytical examinations will be introduced, with analytical analysis of the intact food materials, moreover, the electro analytical, spectroscopic examination of food.  Rapid microbiological methods will be introduced: rapid microbiological tests, automatic microbiological methods. Methods examining chemical or physical characters in microbiological tests, moreover, immunological and DNA based method will be demonstrated.  Students will be able to choose and perform the appropriate analytical or microbiological rapid method for the examination of food.   1. Electro analytical methods: conductometry, voltammetry 2. Spectroscopic methods: IR spectrometry 3. Spectroscopic methods: NMR; Radiochemical methods. 4. Refractometry, Polarimetry 5. Chromatography: thin layer Chromatography 6. Automatization of classical microbiological analysis, Rapid hygienic tests 7. Microbiological rapid methods based on detection of physical characters. 8. Microbiological rapid methods based on detection of chemical characters. 9. Immunological methods in food microbiology. 10. Polimerase chain reaction based methods in food microbiology. |
| **Summary of content - practice**: |
| Skills to be learnt: to use analytical methods and build some equipment with sensors. Skill to be used in simple microbiological rapid methods.     1. Arduino and sensors in the measurements 2. Programming of Arduino 3. Building and testing a simple photometer 4. Measurement of color 5. Making an equipment ofr measurement of light scattering (turbidimetry and nephelometry 6. Characterise microbiological rapid methods for determining the numbers of microorganisms 7. Finding application possibilities for the microbiological rapid methods based on detection of physical characters 8. Finding application possibilities for the chemical based microbiological rapid methods 9. Finding application possibilities of immunological rapid methods for food microbial analysis 10. Set up a plan for PCR detection of a foodborne pathogen. |
| **Literature, handbooks in English** |
| https://www.arduino.cc/en/Booklet/HomePage  Püssa T (2013): Principles of Food Toxicology. CRC press. ISBN 9781466504103  Omaya S. T (2004): Food and Nutritional Toxicology. CRC press. ISBN 9781587160714  D'Mello J P F (2003): Food Safety: Contaminants and Toxins CABI, 480p  Madigan, M. T, Martinko, J. M., Bender K., Buckley, D., Stahl, D (2015): Brock Biology of Microorganisms, Benjamin Cumming, 14th edition 1030 oldal, ISBN 978-1-292-01831-7 |
| **Competencies gained** *(acc. to the Regulation on training and outcome requirements)* |
| 1. **Knowledge:**  * Have a good understanding of analytical methods and applications.  1. **Skills:**  * The student identifies specific problems and opportunities in the sensor technology and microbiological evaluations with an interdisciplinary approach.  1. **Attitude:**  * Committed to his profession, he knows and undertakes its core values and norms, strives to critically interpret and develop them, and solves problems on a professional basis. * The student recognizes values in the field of rapid anyalitical methods.  1. **Autonomy and responsibility:** |

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| **Responsible lecturer: József Prokisch, Ph.D.** |
| **Other lecturer(s): Erzsébet Karaffa, Ph.D.** |

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| **Terms of course completion:** |
| 1. Participating in the seminars 2. Completing topic literature summary and presentation 3. Written exam |
| **Form of examination:** |
| Written form |
| **Requirement(s) to get signature:** |
| 1. Participating in the practice |

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| **Exam questions:** |
| 1. Principles of metrology 2. Microcontrollers, sensors, Arduino, programming 3. Measuring of basic parameters like weight, mass, volume, pressure, temperaturre, density, viscosity 4. Water-activity importance, meaning and measuring methods 5. Thermal analysis 6. Spectroscopy 7. Refreaktometry 8. Turbidimetry, nefelometry 9. Polarimetry 10. Electroanalytical methods (Potentiometry, Coulometry, Voltammetry: Polarography, Amperometry) 11. Radioanalytical methods 12. Criteria for microbiological rapid methods. Possibilities for identification and quantification. 13. List the steps for conventional standard plate count for enumeration microbes from food. Give possibilities to accelerate some steps 14. Minimum 3 examples for the microbiological examination of surfaces 15. Possibilities for the microbiological examination of air 16. Possibilities for the rapid enumeration of microbial cells 17. The name and major characteristics of the three most important membrane filter-based determination of the number of microbial cells 18. Major characteristics of microscopic count and dye reduction. Concept and examples. 19. Usage of impedance measurement for the detection of microbes. Concept and examples 20. Working principle of turbidimetry and microcalorymetry. Types of colorimeters and, and example 21. Working principle of Flow cytometry, and example 22. Working principle of electronic nose, and example for usage in food microbiology. 23. List the most important chemical methods in food microbiology 24. Major characteristics of thermostable nuclease (target, advantages and disadvantages) 25. Major characteristics of Limulus Lysate for Endotoxins - LAL (target, detection method) 26. Major characteristics of Adenosine Triphosphate Measurement (target, detection methods) 27. Possibilities for detecting CO2 production of microbes (target, detection method) The role of Fluorogenic and Chromogenic Substrates in food microbiology. Some examples. 28. Basis of immunological methods. Type of Gram negative antigens. 29. List the most important immunological methods in food microbiology. Their basic characteristics. 30. Characteristics of immun precipitation and agglutination 31. Give the name and short description of minimum 5 immunological methods. 32. ELISA: description. Examples for food microbiology 33. Western blot and lateral flow immunoassay (characteristics and examples) 34. Nucleic acid probes: description, advantages and disadvantages. minimum 1 example. 35. Basic characteristics of PCR. 36. Different types of PCR. and their characteristics 37. Real time PCR: description. Different types for detection 38. Characteristics and usage of electrophoretic caryotyping and restriction enzymes |