

Detailed Course Descriptions of Food Science Subjects Offered by the Doctoral School of Agricultural and Food Sciences

Course Description

Course title / Neptun code: MATER073N Statistical Methods	Number of credits: 10
Course coordinator (name, position, academic degree): Dr. Márta Ladányi, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. Anna László, PhD	
Course type: <u>compulsory</u> /elective	
Type of class: lecture/ <u>seminar</u> / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): theory, case-study analyses, project-based learning	
Requirements for successful completion: project work submission	
Assessment methods applied for evaluating learning outcomes: commented evaluation of the project work	
Recommended semester: fall (first or second)	
Prerequisites (if any): <i>master level statistical knowledge</i>	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>Based on the knowledge students have acquired in standard Biometrics and Statistics courses at the master's level, selected chapters of advanced statistics will be discussed using complex applications. We work in a computer-based environment. Statistical methods are presented in a practical manner, with numerous agricultural applications tailored specifically to the needs of PhD students, while also addressing special data management issues and proper documentation practices. Students who lack a master's-level statistical background and need to prepare for this course can register for the Biometrics course (MATER074N) to bridge the knowledge gap. They can enrol in both the "Biometrics" and "Statistical Methods" courses in the same fall semester. In this case, the courses will be taught sequentially in intensive blocks, starting with "Biometrics" and followed by "Statistical Methods".</p>	
<p>Course Topics / Semester Schedule:</p> <p>Statistical hypothesis testing, revision: data types, outliers, missing data, Type I and Type II errors, significance level, normality tests, one- and two-sample parametric tests; one-way ANOVA; skewness and kurtosis tests, data transformation, sampling, sample size and power calculation</p> <p>Experimental design, one- and two-way ANOVA, ANCOVA models, GLM, GLMM, repeated measures ANOVA, post hoc tests, graphical representation</p> <p>Linear and nonlinear uni- and multivariate regression models, regression diagnostics, confidence intervals and bands, collinearity, PCA regression, quantile regression, write-up;</p>	

Crosstabulation, ratio tests
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
Special handouts are available during the course.
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Tabachnick, B. G., Fidell, L. S. (2019, e-version 2022). Using Multivariate Statistics (7th ed.). Pearson. ISBN 9780134790541, 0134790545, e-version: ISBN-13: 9780137526543 Andy F. (2024). Discovering Statistics Using IBM SPSS Statistics (6th ed.). SAGE Publications. ISBN 1529668719, 9781529668711</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>a) Knowledge Students acquire statistical methods in an SPSS environment based on real-world research, directly supporting the analyses required for their experimental or observational research, as well as their literature review work. b) Skills Students will be able to analyse data arising from biological-chemical research in a statistically and ethically sound manner, as well as interpret, visually present, and communicate results to a scientific standard. c) Attitude Students develop the scientific rigor necessary for performing high-quality statistical analyses and for critically and insightfully reading statistical analyses in scientific journals. d) Autonomy and Responsibility Students learn to conduct data analysis independently, responsibly, honestly, and precisely.</p>

Course Description

Course title / Neptun code: Publication of scientific results in peer-reviewed journals GENBT097N	Number of credits: 10
Course coordinator (name, position, academic degree): Attila Hegedűs, DSc, professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory	
Type of class: lecture, 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): The transfer of knowledge is carried out through lectures, seminar sessions, and individual assignments. The course involves the analysis of articles published in scientific journals, the use of publication databases (Web of Science, Scopus, and Google Scholar), and the examination of scientometric case studies. Students acquire the subject matter through practical assignments and hands-on exercises.	
Requirements for successful completion: exam	
Assessment methods applied for evaluating learning outcomes: project work	
Recommended semester: autumn	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>The quality of scientific work and the success of researchers are increasingly assessed on the basis of publications resulting from their research. This course introduces the leading international and national journals in horticultural science and outlines the main characteristics of scientific publications, the fundamental requirements for manuscript preparation, the ethical use of artificial intelligence platforms, the independent and anonymous peer-review process, as well as the ethical and technical aspects of scientific publishing. Special attention is given to scientometric indicators that play an increasingly important role in the evaluation of researchers and research outcomes, including the impact factor, citation counts, the Hirsch index (h-index), the g-index, and related metrics, together with their advantages and limitations.</p>	
<p>Course Topics / Semester Schedule:</p> <p>The role of scientific communication in research</p> <p>Overview of the international and national scientific publishing system</p> <p>Leading journals and databases in agricultural sciences</p> <p>Structure of a scientific paper</p> <p>Principles of preparing a publishable manuscript</p> <p>Use of artificial intelligence platforms in scientific writing</p> <p>Literature searching and the use of reference management systems</p>	

<p>Criteria for journal selection</p> <p>Professional editing, manuscript review, and the peer-review process</p> <p>Principles of publication ethics</p> <p>Open-access publishing and predatory journals</p> <p>Scientometric indicators (Impact Factor, CiteScore, h-index, g-index, etc.)</p> <p>Citation analysis and research performance evaluation</p> <p>Researcher identifiers and profiles (ORCID, ResearcherID, Scopus Author ID)</p> <p>Increasing the visibility and impact of research outcomes</p>
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Hyland, K., & Salager-Meyer, F. (2008). Scientific writing. <i>Annual review of information science and technology</i>, 42(1), 297.</p> <p>Alkaissi, H., & McFarlane, S. I. (2023). Artificial hallucinations in ChatGPT: implications in scientific writing. <i>Cureus</i>, 15(2).</p> <p>Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. <i>Proceedings of the National Academy of Sciences</i>, 102(46), 16569-16572.</p>
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Kacena, M. A., Plotkin, L. I., & Fehrenbacher, J. C. (2024). The use of artificial intelligence in writing scientific review articles. <i>Current Osteoporosis Reports</i>, 22(1), 115-121.</p> <p>Jirge, P. R. (2017). Preparing and publishing a scientific manuscript. <i>Journal of Human Reproductive Sciences</i>, 10(1), 3.</p> <p>Aga, S. S., & Nissar, S. (2022). Essential guide to manuscript writing for academic dummies: an editor's perspective. <i>Biochemistry Research International</i>, 2022(1), 1492058.</p>
<p>Professional Competences Developed by the Course</p> <p>Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:</p> <p style="text-align: center;">Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p><u>Knowledge</u></p> <p>Demonstrates an understanding of the fundamental principles governing the scientific publishing system.</p> <p>Demonstrates knowledge of the structure and evaluation criteria of international and national scientific journals.</p> <p>Demonstrates knowledge of the structural and formatting requirements of scientific publications.</p> <p>Demonstrates knowledge of the principal scientometric indicators used to assess research performance.</p> <p>Demonstrates knowledge of the fundamental principles of publication ethics and the requirements of scientific integrity.</p> <p><u>Skills</u></p> <p>Able to select an appropriate scientific journal for publication.</p>

Able to independently search for, retrieve, and critically evaluate scientific literature.

Able to prepare and critically assess scientific manuscripts.

Able to interpret and apply scientometric data and indicators.

Able to plan and prepare scientific publications based on research results.

Attitudes

Strives to communicate research findings in a professional and ethical manner.

Committed to maintaining scientific quality, credibility, and integrity.

Open to understanding and adopting the expectations and standards of the international scientific community.

Autonomy and Responsibility

Able to independently evaluate and utilize scientific literature and information sources.

Takes responsibility for the accuracy of data, references, and citations used in scientific publications.

Independently applies publication and research ethics principles in scientific practice.

Course Description

Course title / Neptun code: MATER075N Multivariate Statistical Analysis	Number of credits: 6
Course coordinator (name, position, academic degree): Dr. András Ittész, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. Márta Ladányi, DSc	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/ <u>seminar</u> / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): theory, case-study analyses, project-based learning	
Assessment methods applied for evaluating learning outcomes: report	
Recommended semester: spring (second or third)	
Prerequisites (if any): <i>advanced level statistical knowledge</i>	
Assessment methods applied for evaluating learning outcomes: commented evaluation of the project work	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p>	
<p>During the semester, students will build on their knowledge acquired in BSc, MSc, or PhD-level Biometrics and Statistics courses. Selected chapters of multivariate statistics, focusing on complex applications, will be explored through practical discussions and numerous examples, particularly from agriculture. The content is tailored to meet the needs of PhD students.</p> <p>The course is taught online, using RStudio as the primary statistical software. Additionally, the block teaching plan is developed in consultation with the students to ensure it aligns with their learning objectives.</p>	
<p>Course Topics / Semester Schedule:</p> <p>The curriculum covers several multivariate statistical methods and focuses on the details of the practical application of the methods, in addition to the basic theoretical background required by the users, in line with the participants' own doctoral work. RStudio software will be used for the practical implementation of the calculations and analyses.</p> <ul style="list-style-type: none"> - General linear models including MANOVA - Multiple linear regression - Logistic regression - Partial least squares regression - Discriminant analysis 	

- Cluster analysis
- Principal component analysis
- Other multivariate statistical methods, some based on machine learning algorithms (PLS, SVM, Random Forest, Generalized Mixed Effects Models etc)

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Special handouts are available in electronic form during the course via the e-learning system.

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Tabachnick, B. G., & Fidell, L. S. (2022). Using Multivariate Statistics (7th ed.).

Pearson. ISBN-13: 9780137526543

Field, Andy P. (2026). Discovering Statistics Using R and RStudio. SAGE Publications. ISBN 978-1-5264-6136-0

Podani J. (1994). Multivariate Data Analysis in Ecology and Systematics. SPB, The Netherlands. Ecological Computations Series, vol. 6. ISBN 90-5103-0940

Podani J. (2000). Introduction to the Exploration of Multivariate Biological Data.

Backhuys Publishers, Leiden, The Netherlands. ISBN 90-5782-067-6

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

a) Knowledge Students acquire statistical methods in RStudio environment based on real-world research, directly supporting the multivariate data analyses required for their experimental or observational research, as well as their literature review work.

b) Skills Students will be able to analyse complex multivariate data arising from biological-chemical research in a statistically and ethically sound manner, as well as interpret, visually present, and communicate results to a scientific standard.

c) Attitude Students develop the scientific rigor necessary for performing high-quality multivariate statistical analyses and for critically and insightfully reading statistical analyses in scientific journals.

d) Autonomy and Responsibility Students learn to conduct multivariate data analysis independently, responsibly, honestly, and precisely.

Course Description

Course title / Neptun code: Image processing in food research / ÉLTUD244N	Number of credits: 6
Course coordinator (name, position, academic degree): Ferenc Firtha PhD habil.	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Presentation, measurements, data processing	
Requirements for successful completion: -	
Assessment methods applied for evaluating learning outcomes: consultations, project work	
Recommended semester: 1..3	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>This course introduces the research and food industry applications of image processing and spectral image processing. After introducing the basics of numerical analysis and software development tools, it covers the main steps, their implementation, and their prerequisites: segmentation, image corrections, color measurement, shape description (e.g., classification), and pattern characterization (e.g., porosity of baked goods, marbling of meat). We will practice spectral image processing: measurement, data reduction, and building chemometric models.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Numerical analysis</p> <p>Software development tools</p> <p>Steps of image processing</p> <p>Application, measurement practice</p> <p>Hiperspectral image processing</p> <p>Application, measurement practice</p> <p>Individual project work</p>	
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>	
Digital files on https://fizika.hu server	

<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Digital files on https://fizika.hu server</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>Ability to use digital tools independently</p>

Course Description

Course title / Neptun code: Statistical Case Studies in Food Science	Number of credits: 8
Course coordinator (name, position, academic degree): László Baranyai, professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/ <u>seminar</u> / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): case presentations, tutorials	
Requirements for successful completion: participation on lessons, project presentation	
Assessment methods applied for evaluating learning outcomes: presentation in workshop	
Recommended semester: Spring of 1-4	
Prerequisites (if any): <i>none</i>	
Course Description	
The objective of the course is to introduce application of multivariate methods (like SVM, NN), with special emphasis on the optimization of parameters. All methods are introduced with validation, like bootstrapping and Monte Carlo Cross Validation. Cloud based data analysis is introduced with online interactive dashboard.	
Course Topics / Semester Schedule: <ul style="list-style-type: none"> - Utilization of descriptive statistics - Relationship between sample size, accuracy, p-value - Classification methods - Regression methods - Cross validation methods and their evaluation - Cloud based analysis reports (Posit RServer, Google Data Studio) 	
List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)	
<ul style="list-style-type: none"> - Måns Thulin: Modern Statistics with R. Second Edition. Chapman & Hall/CRC Press. ISBN 9781032512440. https://www.modernstatisticswithr.com/ - TIBCO Software Inc. (2020). Data Science Textbook. https://docs.tibco.com/data-science/textbook - Posit Academy Resources. https://posit.co/content-library 	
List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials)	

- Steve Wexler, Jeffrey Shaffer, Andy Cotgreave: The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios. Wiley & Sons. ISBN 9781119282716.
- Peter C. Bruce, Peter Gedeck, Janet Dobbins: Statistics for Data Science and Analytics. Wiley & Sons. ISBN: 9781394253814.

Professional Competences Developed by the Course

Knowledge: best practices on multivariate data analysis; validation of results;
 Skills: data analysis and visualization;
 Attitudes: critical thinking; developing team and selecting team roles;
 Autonomy and Responsibility: pro-active independent work on assigned role;
 responsible for own work;

Course Description

Course title / Neptun code: Advances in sensory science / ELTUD246N	Number of credits: 8
Course coordinator (name, position, academic degree): Zoltán Kókai, professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/elective elective	
Type of class: lecture /seminar / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Students prepare a short presentation in a project work, based on an English-language academic article of their choice. The article should be related to sensory evaluation. Students present their project work orally.	
Requirements for successful completion: Practical grade based on the presentation given	
Assessment methods applied for evaluating learning outcomes: the application of knowledge related to sensory evaluation in the presentation material.	
Recommended semester: elective course, available in the fall semesters	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>The field of sensory evaluation has undergone significant changes in recent decades. The aim of this course is to familiarize students in the doctoral program in food science with state-of-the-art methods and research trends, as well as the most important standards and sensory evaluation softwares.</p>	
<p>Course Topics / Semester Schedule:</p> <p>Week 1: The Development of Sensory Science</p> <p>Week 2: Overview and Classification of Sensory Testing Methods</p> <p>Week 3: Standards Systems—ISO, ASTM, and National Standards</p> <p>Week 4: Common Experimental Design Errors and How to Avoid Them</p> <p>Week 5: Sensory statistics—basic and complex methods</p> <p>Week 6: Consumer tests—critical points, potential errors</p> <p>Week 7: Experts—advantages and limitations of their use</p> <p>Week 8: Software support for sensory testing</p> <p>Week 9: Sensory Textbooks, Organizations, Conferences, and Journals</p> <p>Week 10: Novel Sensory Methods</p> <p>Week 11: Presentation of Student Projects</p> <p>Week 12: Presentation of Student Projects</p>	

Week 13: Presentation of Student Projects
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
Lectures and supplementary materials uploaded to the course's e-learning site.
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials) Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>
<p>Stone, H., Bleibaum, R. N., & Thomas, H. A. (2020). <i>Sensory evaluation practices</i>. Academic press. Civille, G. V., Carr, B. T., & Osdoba, K. E. (2024). <i>Sensory evaluation techniques</i>. CRC press.</p>
<p>Professional Competences Developed by the Course Please specify the professional competences, competence elements and skills to which the course substantially contributes, including: Knowledge, Skills, Attitudes, Autonomy and Responsibility</p>
<p>a) Knowledge - Is familiar with the main products of the food industry, their raw materials, production technologies, and the factors that fundamentally determine food quality and safety in the context of health-conscious nutrition</p> <p>b) Skills - Is able to perform laboratory, pilot-plant, and production tasks, operate machinery and equipment, and apply new methods across the entire spectrum of food production, while complying with environmental and health protection regulations.</p> <p>c) Attitude - Is committed to food quality, food safety, and environmentally friendly solutions that promote the health of individuals and society.</p> <p>d) Responsibility - Solves professional problems arising in the food industry independently or in collaboration with others, taking personal responsibility and adhering to the ethical standards of the profession.</p>

Course Description

Course title / Neptun code: ELTUD234N	Number of credits:8
Course coordinator (name, position, academic degree): Prof. Quang D. Nguyen, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Assoc. Prof. Erika Bujna PhD, Assoc. Prof. Andrea Pomázi PhD, Dr. András Nagy Senior Research Fellow, PhD	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: ..24.. contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods):	
Requirements for successful completion:	
Assessment methods applied for evaluating learning outcomes: essay, written exam	
Recommended semester spring	
Prerequisites (if any):	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>This course covers some important chapters in the field of biotechnology, with particular emphasis on the applications of microorganisms and enzymes in the food production and in the valorisation of food waste, of bioinformatics and protein-engineering, biosensors in food sector, on ethical issues and regulations, food safety assessment of GMO. Additionally, it also covers aspects of sustainable nutrition and health, as well as application of <i>in vitro</i> and <i>in vivo</i> animal models in nutrition and food product and technology developments.</p>	
<p>Course Topics / Semester Schedule:</p> <ul style="list-style-type: none"> – Biocatalysis in food industry – Fermented and functional food – Bioinformatics and protein engineering – Genetic and metabolic engineering – Biorefinery and sustainability – Application of AI in food biotechnology – Food biotechnology in nutrition – Detection of GMO – Ethical and regulation in food biotechnology 	
List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)	

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Shetty K, Paliyath G, Pometto A, Levin E. R. (Eds): Food Biotechnology. Taylor & Francis Group, ISBN: 9780824753290, Second Edition, 2005
- Panesar PS, Marwaha SS (Eds): Biotechnology in Agriculture and Food Processing- CRC Press, ISBN: 9781439888360, 2013
- Whitehurst RJ, van Oort M: Enzymes in Food Technology. Wiley-Blackwell, ISBN: 9781405183666, 2009

List of the 2–5 Most Important Recommended Literature
(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Alberghina L (Ed): Protein engineering in industrial biotechnology. Routledge, ISBN 9780367398972, 2000
- Köhrer C, Rajbhandary (Eds): Protein engineering. Springer, ISBN 9783540709374, 2009
- Vladimir S. Kurćubić; M. Miletic, Nemanja; B. Stajić, Slaviša; Marko M. Petković (Eds): Healthier Food: Design and Development of Foods with Improved Functional and Nutritional Properties. Springer, ISBN 9783031966095, 2025

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Course Description

Course title : New Analytical methods and technique/ Neptun code: ELTUD235N	Number of credits: 8
Course coordinator (name, position, academic degree): Dr. Fodor Péter, emeritus professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/ <u>elective</u>	
Type of class: <u>lecture/seminar</u> / practical / <u>consultation</u> , and total number of contact hours in the semester: .8.. contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Knowledge transfer, review of fundamental concepts, introduction to new regulations and methods, presentation of European practices, overview of Codex Alimentarius methods, troubleshooting and validation of tasks developed by participants, and case studies.	
Requirements for successful completion: Case study	
Assessment methods applied for evaluating learning outcomes: Fitness for purpose	
Recommended semester Autumn	
Prerequisites (if any): Analytical chemistry	
<p>Course Description</p> <p>The aim of the course is to familiarize doctoral students with the measurement parameters and sources of error in modern instrumental analysis using Eurachem guidelines; this involves examining the validation steps for specific types of instruments (focusing on the most common ones) and addressing sources of error and planning stages associated with sampling, while taking into account the students' specific research projects.</p>	
Course Topics / Semester Schedule: Meeting the purpose of the analytical measurement, steps of systematic troubleshooting, planning and execution of validation, sources of uncertainty.	
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials) numbers (if applicable), and ISBN.</p> <p>Eurachem guides: The Fitness for Purpose of Analytical Methods, 2025, Planning and reporting method validation studies, 2025, Measurement uncertainty arising from sampling 2019</p>	
<p>List of the 2–5 Most Important Recommended Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p> <p>Eurachem Guides:</p> <p>Quantifying uncertainty in Analytical Chemistry</p>	

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

international nature, official and literary acceptance, traceability

Course Description

Course title / Neptun code: ELTUD251N	Number of credits: 6
Course coordinator (name, position, academic degree): Zoltán Gillay, Dr. associate professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Eszter Vozáry, Dr. r. associate professor, candidate of Biol. Sci.	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: .. 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): theoretical foundations are presented in lectures. For student measurements: conducting measurements and preparing a report based on the collection of literature history	
Requirements for successful completion: colloquium	
Assessment methods applied for evaluating learning outcomes: evaluation of reports	
Recommended semester autumn/spring	
Prerequisites (if any): no	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
Optical and electrical properties of foods, deepening of MSc level knowledge. Optical – visible and infrared – spectroscopy of foods, electrical impedance spectroscopy. Measurement and evaluation of the near infrared (NIR) spectrum of foods. Definition of electrical impedance, its relationship with material properties – electrical conductivity, dielectric constant. Electrical impedance spectroscopy: measurement methods, interpretation of spectrum, determination of the impedance spectrum of foods, electrical circuit model of foods. Practical applications: determination of moisture content during drying, determination of salt content during pickling; monitoring of structural changes, for example, under pressure.	
Course Topics / Semester Schedule: Week 1: Measurement of color and light absorption of foods during storage or after processing. Week 2-3: Determination of NIR spectrum in foods. Week 4-5: Measurement of electrical impedance spectrum of different foods, approximation of the measured spectrum with electrical circuit models Week 6-7: Determination of water content in a drying object using electrical impedance spectroscopy. Week 8-9: Determination of salt content of meat during pickling using electrical impedance parameters.	

Week 10-11: Determination of complex electrical permittivity.

Week 12-13: Foods in microwave space.

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

S. Martinsen O.G. *Bioimpedance and bioelectricity, Basics*, Elsevier, 2008 ISBN: 978-0-12-374004-5

Figura, L.O., Teixeira A.A.: *Food Physics* , Springer, 2007

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

Rao, M.A. Rizvi, S.S.H.: *Engineering Properties of Foods* (3rd ed)2014 Taylor and

Francis Boca Raton CRC Press DOI <https://doi.org/10.1201/9781420028805>

Témához tartozó szakcikkek

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

- a) knowledge: - Knows and understands the basic principles, machines, equipment and instruments of broadly interpreted food industry operations, as well as their operation in practice.
- b) skills - Able to perform partial tasks in the development and design of technological systems, in the development of new processes and products. - Able to manage and control enterprises, companies, production plants and medium-sized and small enterprises (SMEs) operating in the food industry at an engineering level and to operate their management professionally, taking into account quality assurance, quality control and environmental protection regulations. - Able to effectively self-train, plan and organize their own independent learning, and to find the necessary resources for this.
- c) attitude - Approaches professional issues constructively, is proactive, receptive to new ideas, and strives to make decisions in unexpected decision-making situations with full consideration of legal regulations and ethical standards. - Receptive to the knowledge required for the operation of tools and equipment related to food industry processes. - Committed to food industry R&D&I activities.:

Course Description

Course title / Neptun code: Microbiological food safety and quality/ELTUD334N	Number of credits: 8
Course coordinator (name, position, academic degree): Dr. Gabriella Kiskó, professor, PhD	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>mandatory elective</u>	
Type of class: <u>lecture</u> /seminar / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Following the thematic lectures, students complete a project related to a product of their choice and give a short presentation about it.	
Requirements for successful completion: short presentation on a chosen topic	
Assessment methods applied for evaluating learning outcomes: grade offered based on presentation or oral exam during exam period	
Recommended semester: 2.	
Prerequisites (if any):	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>This course focuses on microbiological aspects of food safety and quality during the production of food raw materials, food manufacturing, storage, and distribution. It provides an overview of the microbiological aspects of food processing technologies. Furthermore, it aims to provide a critical analysis of microbiological testing methods to ensure food safety and quality.</p>	
<p>Course Topics / Semester Schedule:</p> <ol style="list-style-type: none"> 1. Introduction, Microecological Factors 2. Foodborne Pathogenic Bacteria 3. Mycotoxin-Producing Fungi 4. Viruses and Parasites 5. Microbiological Background of Traditional and New Preservation Methods 6. Microbiology of vegetable processing, meat, milk, grains, the milling industry, the baking industry, and confectionery 7. HACCP 8. Modern, rapid, and automated methods in food microbiology and control 	
<p>List of the 2–5 Most Important Required Literature (textbooks, lecture notes, or other study materials)</p> <p>Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.</p>	

- Food Microbiology: Fundamentals and Frontiers 4TH EDITION Edition by Michael P. Doyle published by Amer Society for Microbiology (2012), ASM Press, Washington DC, ISBN 978-1-55581-626-1—ISBN 978-1-55581-846-3 (e-book), <https://www.pdfdrive.com/food-microbiology-fundamentals-and-frontiers-d175273799.html>
- Montville, T.J., Matthews, K.R.: Food Microbiology. An Introduction. Second Edition. ASM Press, Washington DC, 2008. ISBN 978-1-55581-396-3

List of the 2–5 Most Important Recommended Literature
(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Luning, P.A., Devlieghere, F., Verhé, R. (szerk.) 2006. Safety in the agri-food chain, Wageningen Academic Publishers.
- Jay, J., Loessner, M.J., Golden, D.A. 2005. Modern food microbiology, Springer, New York.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Learning about and understanding the general and specific characteristics, interrelationships, and operational features of the food chain, as well as the terminology used to describe them and the connection between food chain safety and quality. Learning about and identifying the consequences of errors and deficiencies occurring in the food chain. Understanding the roles of various sectors of society in promoting food quality and safety.

Course Description

Course title / Neptun code: <i>I Living Lab on Artificial Intelligence</i>	Number of credits: 6
Course coordinator (name, position, academic degree): Zoltan Gillay, PhD, Associate Professor	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): every semester another lecturer joins as a coach from a different University	
Course type: elective	
Type of class and total number of contact hours in the semester: practical, 35 contact hours	
Teaching methods and specific educational tools used for knowledge transfer: project-based learning using Design Thinking, international teamwork, coaching, user and stakeholder research, collaborative ideation, prototyping, online collaboration, e-portfolio and presentations.	
Requirements for successful completion: active participation in the team project; completion of the project work through a prototype; submission of an e-portfolio; participation in the final presentation and assessment talk.	
Assessment methods applied for evaluating learning outcomes: continuous assessment of active cooperation and teamwork, evaluation of the e-portfolio, prototype and final presentation, complemented by a final assessment talk.	
Recommended semester: fall + spring	
Prerequisites (if any): none	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
<p>In this project course, international groups of students from different European universities work on real-world problems that vary each year. The instructor supports the problem-solving process primarily in a coaching role.</p> <p>The objective of the course is to develop knowledge and skills directly related to the needs of professional practice, including creativity, computational thinking and digital literacy, new media literacy, social intelligence, design mindset, novel and adaptive thinking, sense-making, virtual collaboration, cognitive load management, cooperation skills and a future-oriented mindset. Students work together with other learners, lecturers and external stakeholders such as businesses, organizations and public bodies, while using modern information technologies and databases.</p> <p>The course follows a user-centred co-creation process based on Design Thinking. Activities include researching the challenge, empathizing with end users, defining the problem, generating possible solutions, selecting and developing a solution concept, and creating a prototype.</p>	

The I Living Lab team co-creates a solution to a real-world challenge using a user-centred approach. Empathy is a central element of the process: students seek to understand the users' perspectives, needs and experiences in the given context.

The special focus of this I Living Lab is Artificial Intelligence and/or Robots in Wellbeing for Disabled People. These technologies may provide opportunities to improve the quality of life of people living with disabilities, illnesses or special needs, including food allergies.

Course Topics / Semester Schedule:

1. Introduction to the I Living Lab and Design Thinking; presentation of the challenge and team formation.
2. Exploration of the challenge: background research, context analysis and stakeholder mapping.
3. Empathize: user and stakeholder research; identification of needs, experiences and perspectives.
4. Define: synthesis of findings and formulation of a clear, user-centred problem statement.
5. Ideate: creative generation of alternative solutions using collaborative idealization methods.
6. Concept evaluation and selection: comparison of ideas and development of the selected solution concept.
7. Prototype: design and development of a tangible or digital prototype representing the proposed solution.
8. Final presentation and reflection: presentation of the prototype, e-portfolio and reflection on teamwork and learning outcomes.

**List of the 2–5 Most Important Required Literature
(textbooks, lecture notes, or other study materials)**

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

1. Doorley, S., Holcomb, S., Klebahn, P., Segovia, K., & Utley, J. (2018). Design Thinking Bootleg. d.school at Stanford University.
2. Huion, P. (Ed.), Sayer, H., Aycicek, H., Malai, L., Ronco, M., Pinto-Bello Gomez, R., & Cijis, E. (2021). Methodological Guide: The Community Project. Diepenbeek: UCLL.
3. Westerlund, M., Leminen, S., & Habib, C. (2018). Key Constructs and a Definition of Living Labs as Innovation Platforms. *Technology Innovation Management Review*, 8(12), 51-62.

**List of the 2–5 Most Important Recommended Literature
(textbooks, lecture notes, or other study materials)**

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

1. De Bono, E. (1986). *Six Thinking Hats*. New York: Little, Brown.
2. Stevens, E. (2021). How To Run an Awesome Design Thinking Workshop. UX Design. <https://careerfoundry.com/en/blog/ux-design/design-thinking-workshop/> [Accessed 21 December 2021].
3. Gealapu, A., Fernández, P., Zimmermann, P., Baleti, A., Moreira, S., & Tóth, A. (2022). *Egg.tually – A Healthy Lifestyle Guide for Youngsters*. Forthcoming.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Knowledge

- Understands the principles of Living Lab co-creation and the main stages and tools of Design Thinking.
- Knows methods of information gathering, user and stakeholder research, problem definition, idea generation, concept selection and prototyping.
- Understands the opportunities and limitations of Artificial Intelligence and robotics in the context of the selected wellbeing challenge.

Skills

- Applies user-centred problem-solving methods to real-world challenges and synthesizes information into a clear problem statement and solution concept.
- Communicates and collaborates effectively in an international, interdisciplinary team using written, oral and digital tools.
- Plans and carries out assigned project sub-tasks and contributes to the development and presentation of a prototype.

Attitudes

- Demonstrates empathy, openness, creativity, initiative and constructive cooperation.
- Respects diverse perspectives and considers professional, ethical, social, ecological and sustainability aspects of the proposed solution.

Autonomy and Responsibility

- Takes responsibility for own contributions, deadlines and commitments within the team.
- Makes justified decisions with professional guidance, takes responsibility for statements and project outcomes, and reflects on own learning and professional development.

Course Description

Course title / Neptun code: ELTUD250N	Number of credits:6
Course coordinator (name, position, academic degree): Dr. Koris András, egyetemi tanár	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): Dr. Csighy Attila	
Course type: compulsory/ <u>elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 24 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): The transfer of the given knowledge takes place through lectures and practical sessions.	
Requirements for successful completion: presency	
Assessment methods applied for evaluating learning outcomes: 100% presency	
Recommended semester 1-4	
Prerequisites (if any): -	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>Within the framework of this course, students will learn the theory of modern particle production and characterization techniques, as well as acquire practical skills in using the necessary equipment, instruments, and software.</p> <p>Topics covered:</p> <ul style="list-style-type: none"> • Properties, significance, and applications of microparticles • Methods for measuring particles and particle assemblies • Theory of light scattering-based determinations • Examination of suspensions and emulsions using optical microscopy • Measurement of particle size and distribution, molecular weight, and zeta potential using DLS (Dynamic Light Scattering) • Density measurement of liquids and powders • Viscosity measurement of liquids and mixtures • Analysis of particle size distribution and shape in powders • Characterization of macroscopic and physical properties of powders • Theory of microencapsulation 	
Course Topics / Semester Schedule:	

	type	date	place	topic	teacher	hrs
1	lecture			Properties, importance and uses of nano- and microparticles. Particle crystal structure and crystallography, Composite materials, Modulation of crystal structure by temperature and pH, Particle structure with nano- and micro- scale	Dr. Koris András	6
2	lecture			Density measurement of liquids and powders, viscosity measurement of liquids and mixtures, particle size distribution and shape analyses of powders, characterization of macroscopic, physical powder properties. Properties of Particles and Powders, Methods for measuring particles and their aggregates, Theory of light scattering based determinations.	Dr. Kárpáti Péter, Lab-Ex Kft. Dr. Koris András	6
3	lecture and demo instrument			Design of particle characterisation instruments	tbc	4
4	laboratory practice			Measurement of particle size and distribution, molecular weight and zeta potential by DLS Analysis of suspensions and emulsions by optical microscopy	Dr. Csighy Attila	4
5	lecture			Carbon nanotubes, Carbon polymers Closing remarks and evaluation of the attenders	Dr. Koris András,	4

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

-

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

-

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

Within the framework of this course, students will learn the theory of modern particle production and characterization techniques, as well as acquire practical skills in using the necessary equipment, instruments, and software.

Course Description

Course title / Neptun code: Selected topics of nutrition science/ ELTUD239N	Number of credits: 8
Course coordinator (name, position, academic degree): Livia Simon Sarkadi, full professor/professor emerita, DSc	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree): -	
Course type: compulsory/ <u>mandatory elective</u>	
Type of class: <u>lecture</u> /seminar / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods): Following the thematic lectures, students give a short presentation on a chosen topic and write an essay.	
Requirements for successful completion: short presentation on a chosen topic and essay writing	
Assessment methods applied for evaluating learning outcomes: grade offered based on presentation and essay or oral exam during exam period	
Recommended semester 4 th semester	
Prerequisites (if any): -	
Course Description Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.	
The course aim to introduce some of the major areas of nutrition science including brief history of nutrition, essential macronutrients and micronutrients and their functions, review of major metabolic pathways and human digestive system, the main eating habits, nutritional disorders and diseases, and finally, the global nutrition problems of the 21st century.	
Course Topics / Semester Schedule: <ol style="list-style-type: none"> 1. Introduction. Ethical issues in Science. History of Nutrition. Classification of essential nutrients. 2. Overview of metabolism. Main food groups. Dietary reference intakes. Human digestive system. Energy intake. 3. Type of diets and main models. Healthy diet. Alternative diet. 4. Disorders: malnutrition, obesity, food allergy and food intolerance. The global nutrition problems of the 21st century. 5. Student presentations on selected topics. 	
List of the 2–5 Most Important Required Literature	

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- Pantelis Protopapas: Introduction to Nutrition. ISBN: 9781779562555, Publisher: Arcler Press 2026
- H. Roche, IA Macdonald, SA Lanham-New: Nutrition and Metabolism, 3rd Edition, A John Wiley & Sons, Ltd., Publication, 2023

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

- MJ Gibney, SA Lanham-New, A Cassidy, HH Vorster: Introduction to Human Nutrition, A John Wiley & Sons, Ltd., Publication, 2009
- Thomson, Manore: Nutrition. An applied approach. ISBN 978-0-321-69664-9, 2012, Pearson Education, Inc.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

The processes of digestion and absorption, and key functions of nutrients in the body. The nature of metabolic demand for nutrients and nutritional requirements. The consequences and identification of nutrient deficiencies. Dietary reference values and safe upper limits. Role of different sectors in society in promoting nutritional health.

Course Description

Course title / Neptun code: New trends in molecular biology / ELTUD359N	Number of credits: 6
Course coordinator (name, position, academic degree): Ágnes Belák, associate professor, PhD.	
Instructor(s) involved in teaching the course, if applicable (name, position, academic degree):	
Course type: compulsory/elective/ <u>compulsory elective</u>	
Type of class: lecture/seminar / practical / consultation, and total number of contact hours in the semester: 26 contact hours	
Teaching methods and specific educational tools used for knowledge transfer (e.g. case presentations, case-study analyses, project-based learning, other methods):	
Knowledge transfer is based on interactive, student-centred teaching methods. Each topic is introduced by a brief instructor-led overview, complemented by scientific videos and animations, as well as the joint critical analysis of relevant scientific publications. Through journal club-style discussions, guided scientific debates, and problem-oriented activities, students explore the scientific background, development, applications, and limitations of selected molecular biology technologies.	
Requirements for successful completion: proposed mark	
Assessment methods applied for evaluating learning outcomes:	
Assessment is based primarily on students' active participation and their contributions to group discussions and journal club-style activities. As part of the course requirements, students will give a short presentation on a molecular biology technology or scientific publication of their choice related to the course topic, followed by a group discussion.	
Recommended semester: 3 rd	
Prerequisites (if any): There aren't any, but a basic knowledge of molecular biology is a great advantage	
<p>Course Description</p> <p>Objectives of the course and a concise yet informative description of the knowledge and skills to be acquired.</p> <p>This course explores key molecular biology technologies that originated from Nobel Prize-winning discoveries and have subsequently transformed modern biological research. The course focuses on how fundamental scientific breakthroughs have been developed into widely applicable molecular tools and implemented across diverse fields of life sciences. Through selected examples, students will follow the journey from discovery to technological development and contemporary scientific applications.</p>	

Course Topics / Semester Schedule:

1. From DNA Sequencing to the Genomic Era: This session follows the evolution of DNA sequencing from Sanger sequencing to next-generation and long-read technologies. Applications including whole-genome sequencing, metagenomics and modern genomic analyses will be discussed, together with the opportunities and challenges associated with large-scale sequencing data. (Sanger – DNA sequencing, Nobel 1980)
2. From PCR to Digital PCR: This session introduces the development of PCR from Kary Mullis’s Nobel Prize-winning discovery to modern quantitative and digital PCR approaches. Key principles, major applications, advantages and limitations of PCR-based techniques will be discussed, with particular emphasis on their use in contemporary molecular research. (Kary Mullis – PCR, Nobel Prize in Chemistry 1993)
3. RNA as a Regulatory Molecule: RNA Interference and microRNAs: This session focuses on the discovery of RNA interference and microRNAs and their fundamental role in post-transcriptional gene regulation. Their biological significance and current applications as research tools, biomarkers and potential therapeutic targets will be discussed. (Fire & Mello – RNAi, Nobel 2006; Ambros & Ruvkun – microRNA, Nobel 2024)
4. From mRNA Biology to RNA Therapeutics: This session examines the development of mRNA-based technologies, from fundamental discoveries in RNA biology to modern therapeutic applications. Particular attention will be given to modified mRNA, delivery systems, mRNA vaccines and emerging applications of RNA-based therapeutics. (Karikó & Weissman – Nobel 2023)
5. From GFP to Modern Molecular Imaging: This session presents the discovery and development of green fluorescent protein (GFP) as a molecular tool for visualizing biological processes. The discussion will extend to fluorescent tagging, live-cell imaging and modern microscopy approaches that enable the spatial and temporal investigation of molecular events in cells. (Shimomura, Chalfie & Tsien – GFP, Nobel 2008)
6. CRISPR-Cas: From Bacterial Immunity to Genome Editing: This session explores how the discovery of CRISPR-Cas systems as bacterial adaptive immune mechanisms led to a revolutionary genome-editing technology. Current applications of CRISPR-Cas9, base editing and prime editing will be introduced, alongside their limitations and major ethical considerations. (Doudna & Charpentier – Nobel 2020)

List of the 2–5 Most Important Required Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

1. Alberts, B. et al.: Molecular Biology of the Cell. 7th Edition. W. W. Norton & Company, 2022. ISBN: 978-0-393-88482-1
2. Lodish, H. et al.: Molecular Cell Biology. 9th Edition. W. H. Freeman/Macmillan Learning, 2021. ISBN: 978-1-319-20852-3
3. Carson, S., Miller, H. B., Witherow, D. S., Srougi, M. C.: Molecular Biology Techniques: A Classroom Laboratory Manual. 5th Edition. Academic Press, 2025/2026. ISBN: 978-0-443-26715-4

List of the 2–5 Most Important Recommended Literature

(textbooks, lecture notes, or other study materials)

Provide complete bibliographic information: author(s), title, publication details, page numbers (if applicable), and ISBN.

1. Sanger, F., Nicklen, S., Coulson, A. R. (1977): DNA sequencing with chain-terminating inhibitors. *Proceedings of the National Academy of Sciences*, 74(12), 5463–5467. DOI: 10.1073/pnas.74.12.5463.
2. Mullis, K. B., Faloona, F. A. (1987): Specific synthesis of DNA in vitro via a polymerase-catalyzed chain reaction. *Methods in Enzymology*, 155, 335–350. DOI: 10.1016/0076-6879(87)55023-6.
3. Lee, R. C., Feinbaum, R. L., Ambros, V. (1993): The *C. elegans* heterochronic gene *lin-4* encodes small RNAs with antisense complementarity to *lin-14*. *Cell*, 75(5), 843–854. DOI: 10.1016/0092-8674(93)90529-Y.
4. Jinek, M. et al. (2012): A programmable dual-RNA-guided DNA endonuclease in adaptive bacterial immunity. *Science*, 337(6096), 816–821. DOI: 10.1126/science.1225829.
5. Karikó, K. et al. (2005): Suppression of RNA recognition by Toll-like receptors: The impact of nucleoside modification and the evolutionary origin of RNA. *Immunity*, 23(2), 165–175. DOI: 10.1016/j.immuni.2005.06.008.

Professional Competences Developed by the Course

Please specify the professional competences, competence elements and skills to which the course substantially contributes, including:

Knowledge, Skills, Attitudes, Autonomy and Responsibility

The course contributes to an understanding of the fundamental principles, potential applications and limitations of modern molecular biology methods, as well as to the ability to critically evaluate the relevant scientific literature. It fosters an openness to new scientific findings, independent professional thinking and the responsible, scientifically sound selection of methods appropriate to research problems.