# Syllabus

## *Course Description*

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| **Course Title** | Design, validation and communication of research in food engineering and biotechnology |
| **Course Code** | 46096 |
| **Course Title Additional** | |
| **Scientific-Disciplinary Sector** | NN |
| **Language** | English |
| **Degree Course** | PhD Programme in Food Engineering and Biotechnology |
| **Other Degree Courses (Loaned)** | |
| **Lecturers** | dr. Alberto Ceccon, Alberto.Ceccon@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/55283 |
| **Teaching Assistant** | |
| **Semester** | First semester |
| **Course Year/s** | 2026 |
| **CP** | 4 |
| **Teaching Hours** | 32 |
| **Lab Hours** | 8 |
| **Individual Study Hours** | 60 |
| **Planned Office Hours** | 12 |
| **Contents Summary** | This course provides PhD students with advanced, discipline-oriented methodological frameworks for designing, validating and communicating scientific research in the field of food engineering and biotechnology. The course focuses on strengthening the ability to formulate research-driven questions, develop explicitly testable hypotheses, and design robust and reproducible experimental approaches suitable for complex, multi-factorial biological and technological systems. Through a combination of theoretical lectures and practical activities, students will learn how to critically evaluate scientific literature, assess data quality, robustness and |

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| | reproducibility, and interpret experimental results in a methodologically transparent and scientifically defensible manner. Particular emphasis is placed on the logical structuring of scientific manuscripts, the preparation of effective figures and tables, and the communication and justification of research outcomes and methodological choices through oral and poster presentations. The course also introduces students to the peer review process and provides guidance on responding critically and constructively to reviewers' comments. Overall, the course aims to support PhD students in developing methodologically sound, publishable research outputs and in building a critical, independent and evidence-based scientific mindset. The course is designed to support first-year PhD students in the preparation of their three-year research plan, which is developed in written form and presented to the PhD committee. |
| Course Topics | The course is organized into four interconnected parts—Design, Validation, Communication, and Integration—for a total of 40 hours, combining theoretical lectures, critical discussions, and practical activities. The topics are specifically oriented towards scientific research in food engineering and biotechnology, with particular attention to the methodological challenges of complex biological and technological systems and the development of a coherent three-year PhD research plan.<br><br>Part I – Research Design<br><br>This part introduces the foundations of scientific reasoning and the methodological principles underlying the design of scientific investigations. Topics include the scientific method, the identification of research problems and knowledge gaps, critical evaluation of scientific literature, formulation of research questions, definition of research objectives, and development of testable hypotheses. Particular attention is devoted to experimental design, including the selection of variables and controls, replication, randomization, factorial designs, and the identification of interactions among experimental factors. Basic principles of statistical reasoning, hypothesis testing, and experimental optimization are introduced and applied to research problems relevant to food engineering and biotechnology. |

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| | Part II – Experimental Validation and Data Reliability<br><br>This part addresses the methodological principles required to assess the quality, reliability, and scientific validity of experimental measurements and results. Topics include analytical method validation, accuracy, precision, sensitivity, selectivity, measurement uncertainty, repeatability, reproducibility, and fitness for purpose. The validation of experimental results and predictive models is discussed alongside quality assurance strategies. Further attention is devoted to data organization, critical interpretation of experimental evidence, identification of methodological limitations, and the distinction between statistical significance and scientific relevance. Principles of research integrity, reproducible research practices, transparent reporting, and responsible research data management are also addressed.<br><br>Part III – Scientific Communication and Publication<br><br>This part focuses on the effective organization, presentation, and critical communication of scientific research. Topics include the logical structure of scientific manuscripts, scientific argumentation, preparation of reproducible materials and methods sections, interpretation and discussion of results, and development of effective titles and abstracts. The course addresses publication strategies, scientific integrity, journal selection, and the peer-review process, including critical manuscript evaluation and constructive responses to reviewers. Particular emphasis is placed on the preparation of scientifically informative figures and tables, oral presentations, scientific posters, and the communication and justification of methodological choices, research findings, uncertainties, and limitations to different audiences.<br><br>Part IV – Integration and PhD Research Planning<br><br>The final part integrates the methodological and communication skills developed throughout the course into the preparation and critical evaluation of a scientific research proposal. Students apply the principles of research design, experimental validation, data interpretation, and scientific communication to their individual PhD research topics. Particular attention is devoted to defining the |

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| | scientific background and knowledge gaps, formulating research hypotheses and objectives, selecting appropriate experimental and validation strategies, identifying expected outcomes and potential limitations, and evaluating the overall scientific coherence and feasibility of the proposed research. |
| **Keywords** | Scientific methodology; Research design; Scientific reasoning; Research questions and hypotheses; Critical literature review; Experimental design; Design of Experiments (DoE); Statistical analysis; Analytical method validation; Data quality and reliability; Reproducibility; Research integrity; Data interpretation; Scientific writing; Scientific communication; Peer review; Research proposal development; PhD research planning; Food engineering; Biotechnology. |
| **Recommended Prerequisites** | |
| **Propaedeutic Courses** | |
| **Teaching Format** | The course is delivered through in-person teaching, combining theoretical lectures, interactive discussions, practical exercises, and problem-based learning activities. Lectures introduce key methodological principles using examples from food engineering and biotechnology, while practical activities focus on critical literature analysis, experimental design, data validation and interpretation, and scientific communication.<br><br>Individual and group exercises promote active participation, critical thinking, and peer feedback. Particular emphasis is placed on applying the acquired knowledge to students' individual PhD research projects, supporting the development, presentation, and critical refinement of their three-year research plans. |
| **Mandatory Attendance** | compulsory |
| **Specific Educational Objectives and Learning Outcomes** | 1. Knowledge and Understanding<br>Students will acquire a structured and discipline-oriented understanding of research design, experimental validation and scientific reasoning in food engineering and biotechnology, with particular attention to complex biological and technological systems, data reproducibility and the conceptual structure of multi-year research projects.<br>2. Applying Knowledge and Understanding<br>Students will apply methodological principles to design, justify and |

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| | critically refine their PhD research projects, including the evaluation of experimental constraints, the critical assessment of scientific literature and the interpretation of experimental data, with the objective of developing a coherent and feasible three-year PhD research plan.<br>3. Making Judgements<br>Students will develop the ability to critically assess experimental evidence and methodological choices, identify strengths and limitations in research design, and make evidence-based decisions regarding data interpretation and research strategy, including the prioritization and sequencing of research activities over a multi-year time frame.<br>4. Communication Skills<br>Students will improve their ability to communicate scientific results and underlying methodological choices clearly and effectively, both in written form and through oral and poster presentations, including the structured written and oral presentation of a PhD research plan to an academic audience.<br>5. Learning Skills<br>Through active participation and engagement with course materials, students will enhance their capacity for independent methodological reasoning, critical thinking and continuous scientific development, supporting the progressive refinement of their doctoral research project throughout the PhD programme. |
| **Specific Educational Objectives and Learning Outcomes (additional info.)** | |
| **Assessment** | The assessment is based on two activities designed to evaluate students' scientific reasoning, critical thinking, writing, and communication skills:<br><br>1) Scientific abstract writing: Students prepare a scientific abstract on a research topic relevant to food engineering or biotechnology. The assessment focuses on clarity, scientific accuracy, logical structure, conciseness, and effective communication of research objectives, methodological approaches, and findings.<br><br>2) Oral presentation of a scientific paper: Students select a scientific paper relevant to their research interests and present it |

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| | orally, critically discussing its scientific background, research questions, experimental design, methodological approaches, main findings, and limitations. The assessment considers the clarity and organization of the presentation, critical evaluation of the scientific evidence, and ability to answer questions and justify methodological choices. |
| **Evaluation Criteria** | The evaluation is based on the students' ability to apply scientific reasoning, critically assess research methodologies, and communicate scientific information clearly and effectively, in accordance with the course learning outcomes.<br><br>1. Scientific abstract writing<br><br>The abstract will be evaluated according to the following criteria:<br>-Scientific accuracy and relevance of the content.<br>-Clarity of the research objectives and scientific rationale.<br>-Logical structure and coherence of the abstract.<br>-Appropriate description of methodological approaches and research findings.<br>-Clarity, conciseness, and appropriate use of scientific language.<br><br>2. Oral presentation of a scientific paper<br><br>The presentation will be evaluated according to the following criteria:<br>-Understanding of the scientific background, research objectives, and main findings.<br>-Ability to critically evaluate experimental design, methodological choices, and data interpretation.<br>-Identification of the strengths, limitations, and scientific relevance of the study.<br>-Logical organization, clarity, and effectiveness of oral communication and visual materials.<br>-Ability to answer questions, support scientific arguments, and engage in critical discussion. |
| **Required Readings** | Teaching materials, lecture slides, selected scientific papers, and additional methodological resources will be provided by the instructor during the course. |
| **Supplementary Readings** | |

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| **Further Information** | |
| **Sustainable Development Goals (SDGs)** | Quality education |