Appendix 3

Description of the Learning Outcomes to Be Achieved Through the Programme

Graduates who have earned a Master's degree in "Battery and Hydrogen Technology" from Technische Universität Braunschweig possess extensive, in-depth qualifications in the natural sciences, engineering, and economics, both in terms of subject-specific knowledge and analytical and methodological skills. These competencies build on the educational objectives of a Bachelor's degree programme and prepare students for a career in the field of battery and hydrogen technology. The qualification profile is characterized by the following attributes:

Graduates are able to,

1. explain the fundamental and advanced interrelationships of battery and hydrogen technology along production chains and life cycles; in particular, they can technically analyze the manufacturing, operation, usage, storage, evaluation, and safety-related aspects of battery and hydrogen systems and apply this knowledge to technological issues.
2. systematically analyze complex engineering problems in the fields of battery production, hydrogen as an energy carrier, and electrochemical energy systems; develop appropriate solutions; and evaluate technological options while taking into account engineering, environmental, and energy-related criteria.
3. select and apply modern modeling, simulation, and AI-based methods for addressing tasks in process and system modeling; critically evaluate these methods in terms of their suitability, robustness, and uncertainties; and evaluate real-world data and experimental results using sound methodological approaches.
4. conduct experimental work in the laboratory either independently or as part of interdisciplinary teams, in particular to conduct practical investigations of processes and components in battery and hydrogen technology, systematically record operating and influencing parameters, interpret results, and derive, validate, and apply models to describe system behavior.
5. independently identify current scientific and technological developments in the field of battery and hydrogen technology, work on these developments in interdisciplinary teams, and prepare, present, and discuss the results in a technical manner in a scientific or industrial setting, tailoring their presentation to the specific audience.
6. understand subject-specific and everyday content in German, communicate independently—both orally and in writing—in typical academic, professional, and everyday situations, and present structured arguments on familiar topics and briefly justify them.
7. understand technical and academic content in English, to present complex issues in academic and professional contexts—both orally and in writing—in a precise, structured, and audience-appropriate manner, and to communicate confidently and flexibly in an international professional environment.
8. independently address complex scientific issues and carry out the resulting tasks within interdisciplinary teams organized on the basis of a division of labor; they are also able to incorporate the findings of others, compare them with one another, and present and critically discuss them in national and international contexts.

9. conduct and interpret laboratory-scale experiments—either independently or as part of a small interdisciplinary group—and to discuss and critically evaluate the results with scientific depth.
10. apply cross-disciplinary skills to overcome interdisciplinary challenges in the professional environment and to identify and take into account international and cultural aspects in their problem-solving process.

In addition, **depending on how they have structured their compulsory elective modules**, graduates are able to,

11. apply in-depth knowledge of electrochemical energy storage and conversion systems, hydrogen-based energy systems, industrial hydrogen applications, as well as material cycles, separation and treatment processes, and material-specific issues, to link them together, and to apply this knowledge to the analysis, evaluation, and further development of technological systems if they selected courses in the field of hydrogen and battery technologies.
12. choose and apply advanced mathematical, numerical, and data-driven methods for modeling, simulating, optimizing, and analyzing complex process engineering, electrochemical, and thermofluid dynamic processes, and to critically evaluate the validity of the results if they selected courses in the area of simulation and data analysis.
13. characterize materials, surfaces, coatings, nano- and micromaterials, as well as material-analytical and microscopic examination methods for applications in battery and hydrogen technology; interpret their properties; and utilize this knowledge to evaluate their function, quality, and suitability for use if they selected courses from the field of materials science and analytics.
14. analyze and evaluate production and manufacturing processes, process engineering plants, safety concepts, as well as life-cycle-oriented and energy-efficient engineering approaches for battery and hydrogen technology systems, and to further develop them with regard to sustainability, resource efficiency, and industrial feasibility if they selected courses in the field of production, manufacturing, and plant engineering.
15. contextualize digital technologies, sensor technology, the fundamentals of information technology, and the legal and management-related frameworks for technical systems and industrial value-added processes, and incorporate them into technical, organizational, and strategic decision-making processes in the field of battery and hydrogen technology if they selected courses in the areas of digital technologies and business strategy.