Name of the course: Powering the future: Battery Energy Storage Systems, an AI-Enhanced Training Course.

Teacher: Ernesto Soressi (soressi@ieee.org)

Duration of the course: 16 hours

Credits: 4

Language: Italian; in the presence of a request by foreign students, the course will be held in English.

Aims of the course: This course is designed for doctoral students in electrical and electronics engineering with the aim of providing an in-depth exploration of battery energy storage systems (BESS). The course aims to provide technical understanding of the basic principles, design, management, and integration of BESS with the electrical grid, as well as safety regulation, sustainability, and future innovations. The course emphasizes the use of artificial intelligence to enhance learnings and applications in several areas. Through a combination of lectures, hands-on projects, and AI-enhanced research tools, students will explore cutting edge technologies and methodologies that are shaping the future of energy storage systems.

Teaching program:

1) Introduction to Battery Energy Storage Systems, Battery Basics and Chemistry.
   Overview of BESS and their critical role in modern energy systems.
   Exploring the chemical foundations and types of batteries used in BESS.

2) Design and configuration of Battery Energy Storage Systems
   Detailed look at the architectural consideration for building an efficient BESS

3) Energy Management Systems & BESS Performance.
   Techniques for managing energy flow within BESS and improving grid integration.
   Methods and metrics for assessing the efficiency and performances of battery systems.

4) Safety Protocols in Energy Storage.
   Safety standard and practices critical to operating and maintaining BESS.

5) Toolchains, Simulations & Techno-economic analysis
   How to use advanced simulation tools to model BESS performances and conduct comprehensive techno-economic analysis.

6) Lifecycle and Sustainability of Battery Systems.
   Sustainability Practices in production, usage and recycling of battery systems.

7) Practical Applications and Case Studies
   Analyzing real world implementation and the practical impact of battery systems.

8) Project Presentation and Course Wrap-Up
   Students presents their projects and summarize key learnings from the course.

Course Modality: Each lesson begins with a comprehensive introduction by the teacher using lectures and multimedia presentation. Following the teacher introduction the students are tasked to exploring specific

aspects of the lesson further through research assignments reliant on artificial intelligence. Students will use AI-powered academic search engines or other AI-driven tools.

Final target of the course is also to produce a book on the topic. Each student (or group of students depending on the class size) is assigned a specific topic covered in the course. This topic became the focus of a chapter of the book. The students will write the chapter using guidelines provided by the teacher, ensuring consistency in style, tone, and formatting across the book . Each chapter undergoes a peer review process allowing students to provide and receive constructive feedback. The teacher and academic staff reviews all chapter to make final edits.

Exam modality: The evaluation will include the assessment of the book chapter and a written multiple-choice questionnaire.

Bibliography: Slides (in English) provided by the teacher.