FLEXible **E**lectric **M**achines **LAB**oratory

Profformance+ 2025 Online Award Ceremony,

June 4, 2025

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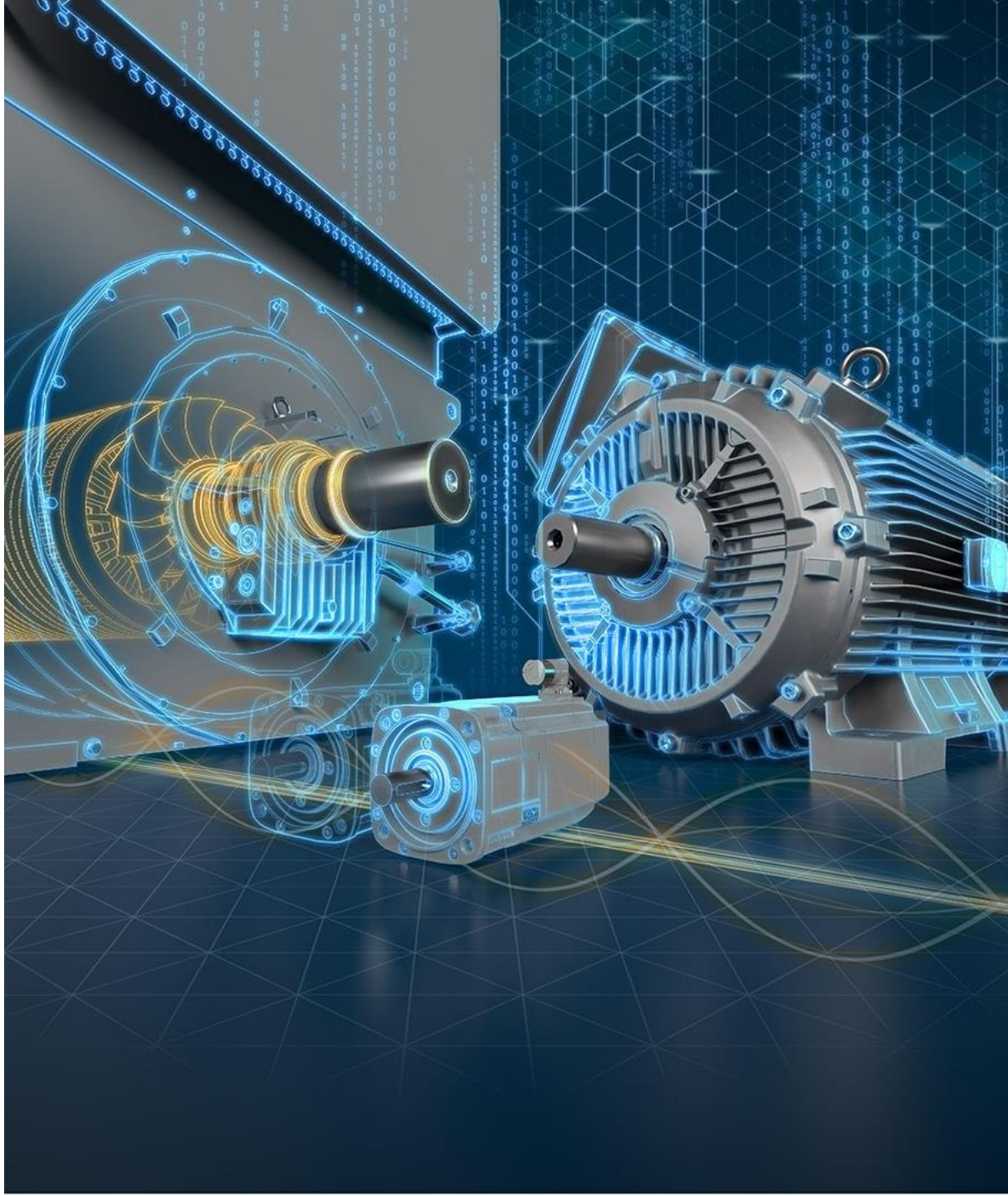

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FLEX-EMLAB team members

- University of Zagreb Faculty of Electrical Engineering and Computing (**UniZG FER**)
- Department of Electric Machines, Drives and Automation:

1) **Project initiator:**
   - **Prof.** Stjepan Stipetić, PhD

2) **Designers:**
   - Filip Jukić, PhD
   - Dražen Kubatović, M. Eng.

3) **Technical support:**
   - **Asst. Prof.** Luka Pravica, PhD
   - **Assoc. Prof.** Martina Kutija, PhD

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Main topic(s)

In accordance with: **EHEA/EU**, **national** and **institutional** priorities

1) Main category:

- Student-centered course design

2) Main horizontal priority

- Sustainability

Key words: electrical machines, sustainable energy conversion, practical engineering education, portability, modularity, cost-effectiveness

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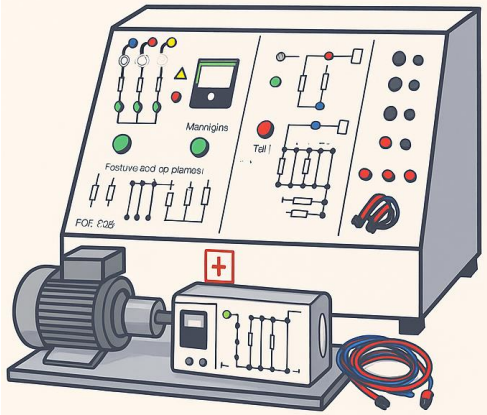
Challenge/problem – objective

Challenge/problem	Objective
Theory – practice gap	Enabling hands-on learning
Adaptation, transport, set-up	Modular and compact design
High-cost equipment	Cost-effective design



LEARNING ENERGY CONVERSION
THEORY AND PRACTICE

MODULAR AND COMPACT DESIGN

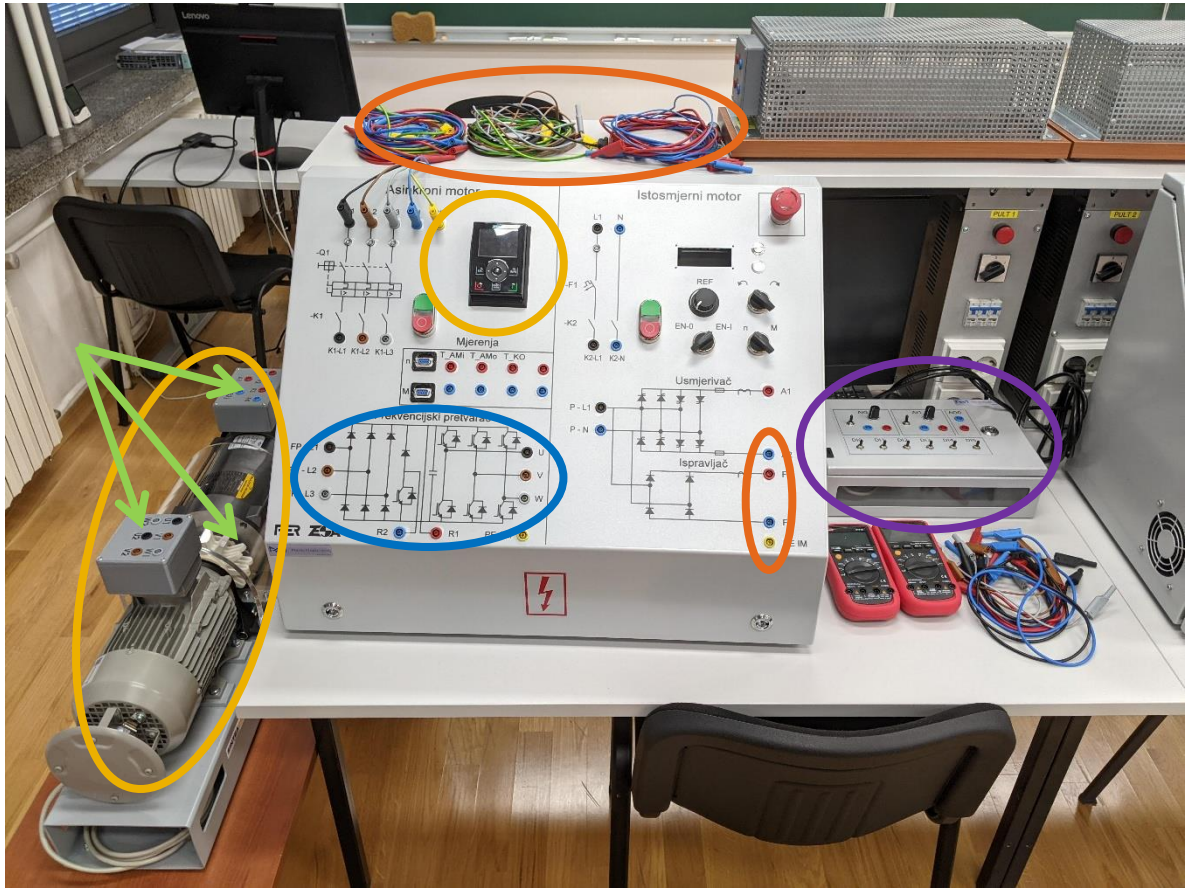
ENABLING HANDS-ON AND PRACTICAL LEARNING

COST-EFFECTIVE PRODUCT

Methodology, outcomes, lessons (1)

- **1) Methodology:**
  - focused on **merging theory with hands-on** engineering practice;
    - **Curriculum-Driven**: response to **new 2018/2019 curriculum**;
    - **Safe, Modular and Smart Design**:
    - standard industrial components: **Siemens, Baldor**, etc.;
    - easy to use and maintain: **wiring diagrams** and **user manuals**;
    - enables flexible configurations;
    - safe experimentation:
      safety banana plugs, switches, mechanical protections;

- **2) Tools and techniques used:**
  - **Advanced Design Tools**: standard tools - **EPLAN** and **SolidWorks**
  - **Custom & Safe Components**: **3D custom printed parts**
  - **Conceptual design:** **2019**
  - **Tested**: **2020**
  - **Improvements:** **additional mini control box**

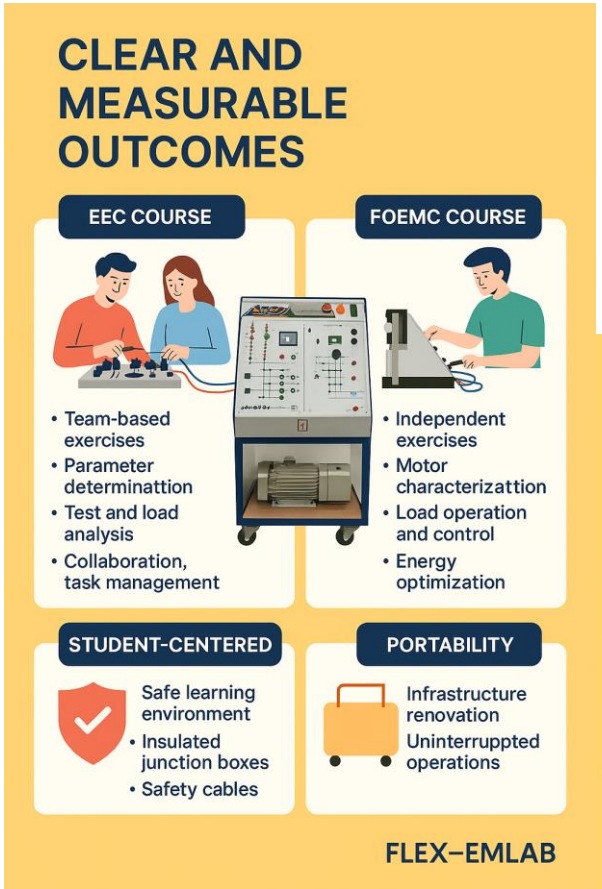


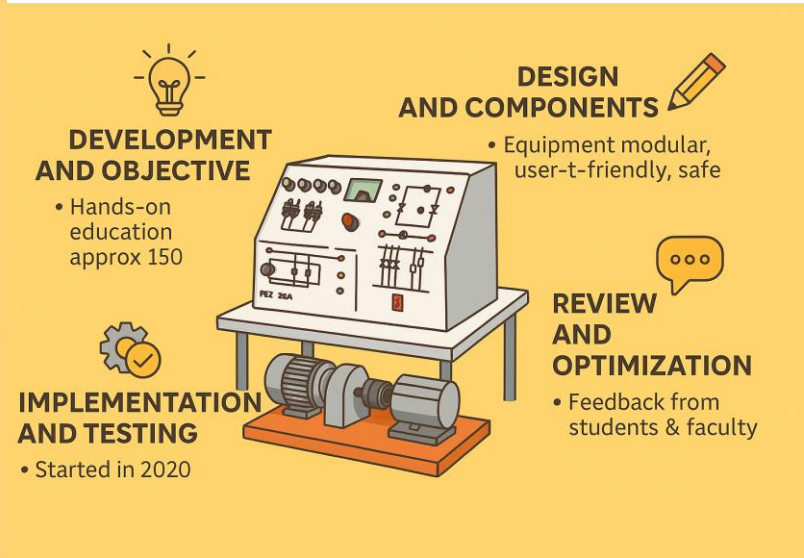
Methodology, outcomes, lessons (2)

- **3) Outputs, outcomes and impact:**
  - **Proven Impact in Teaching**: used since **2020**; **> 150 students** per year
  - **Laboratory exercises:** **EEC** and **FOEMC** courses - DC and IM
  - **Built for Students**: foster **hands-on engineering, collaboration, task management**
  - **Resilient & Portable**: can be **easy adjusted** for **different** environments, needs, etc.

- **4) Lessons learned:**
  - **Educational Focus & Integration;**
  - **Preplanning:** **to cover all requirements**;
  - **Feedbacks:** **to overcome all shortcomings**;

- **5) Adaptability and transferability:**
  - **Adaptable for All Contexts**: **internationalization;**
  - **Customizable and Easy to Implement**: **inclusion;**
  - **Sustainable, Affordable and Long-Term Use:**
    lower income institutions;





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Video

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FLEX-EMLAB

Compact Testbench for Electric Machines

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Thank you for your attention!

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