

# MATLAB in Energy Systems



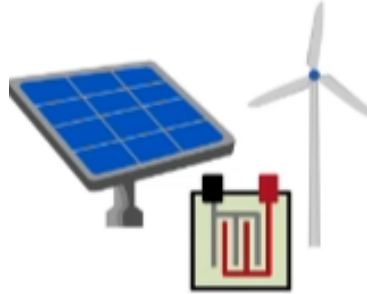
Asst. Prof. Dr. Nezihe YILDIRAN  
Bahçeşehir University  
[nezihe.kucukyildiran@bau.edu.tr](mailto:nezihe.kucukyildiran@bau.edu.tr)

# Experimental Design in Energy Systems

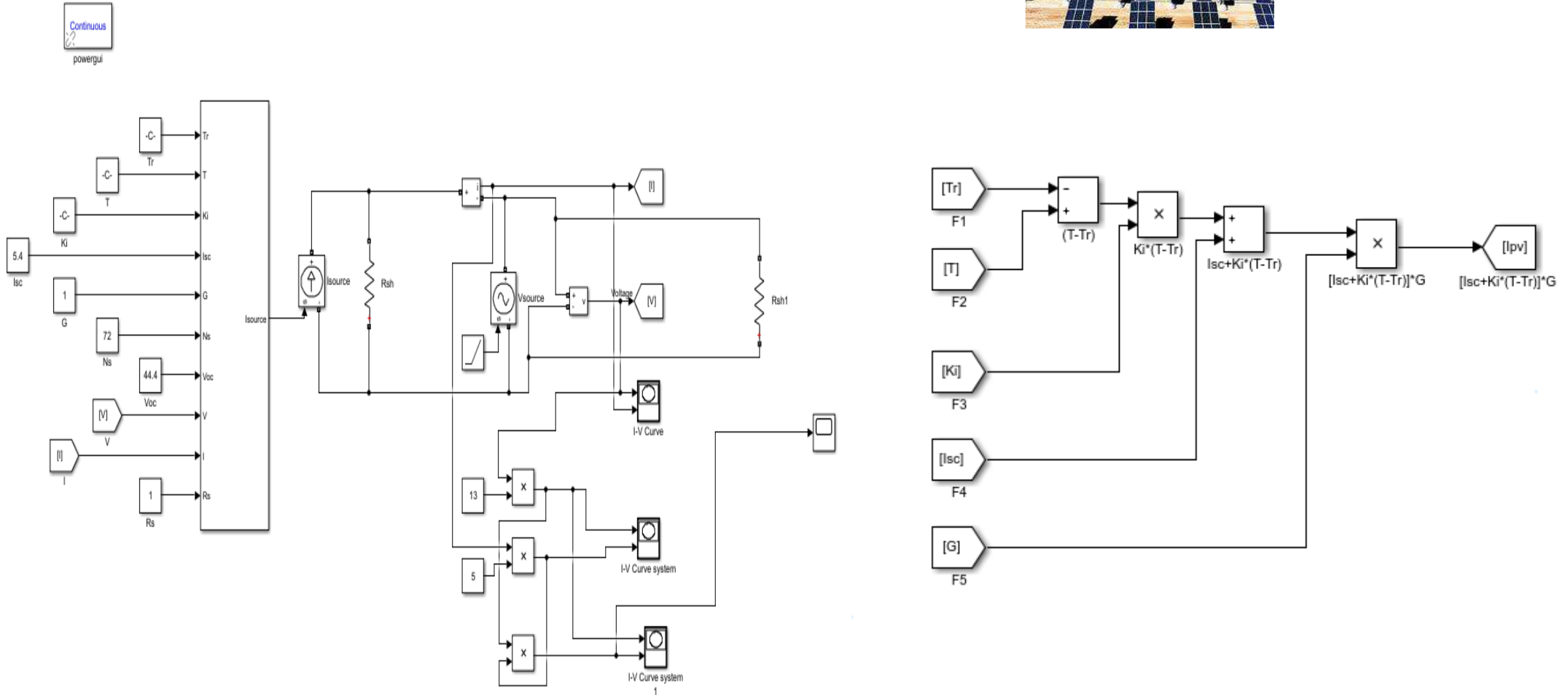
- Faculty of Engineering and Natural Sciences
- Energy System Engineering
- 4<sup>th</sup> year
  
- Learning objectives
  - Identify, formulate and solve engineering problems
  - Design complex systems, processes, devices or products to meet desired needs within the realistic constraints and conditions

# Experimental Design in Energy Systems

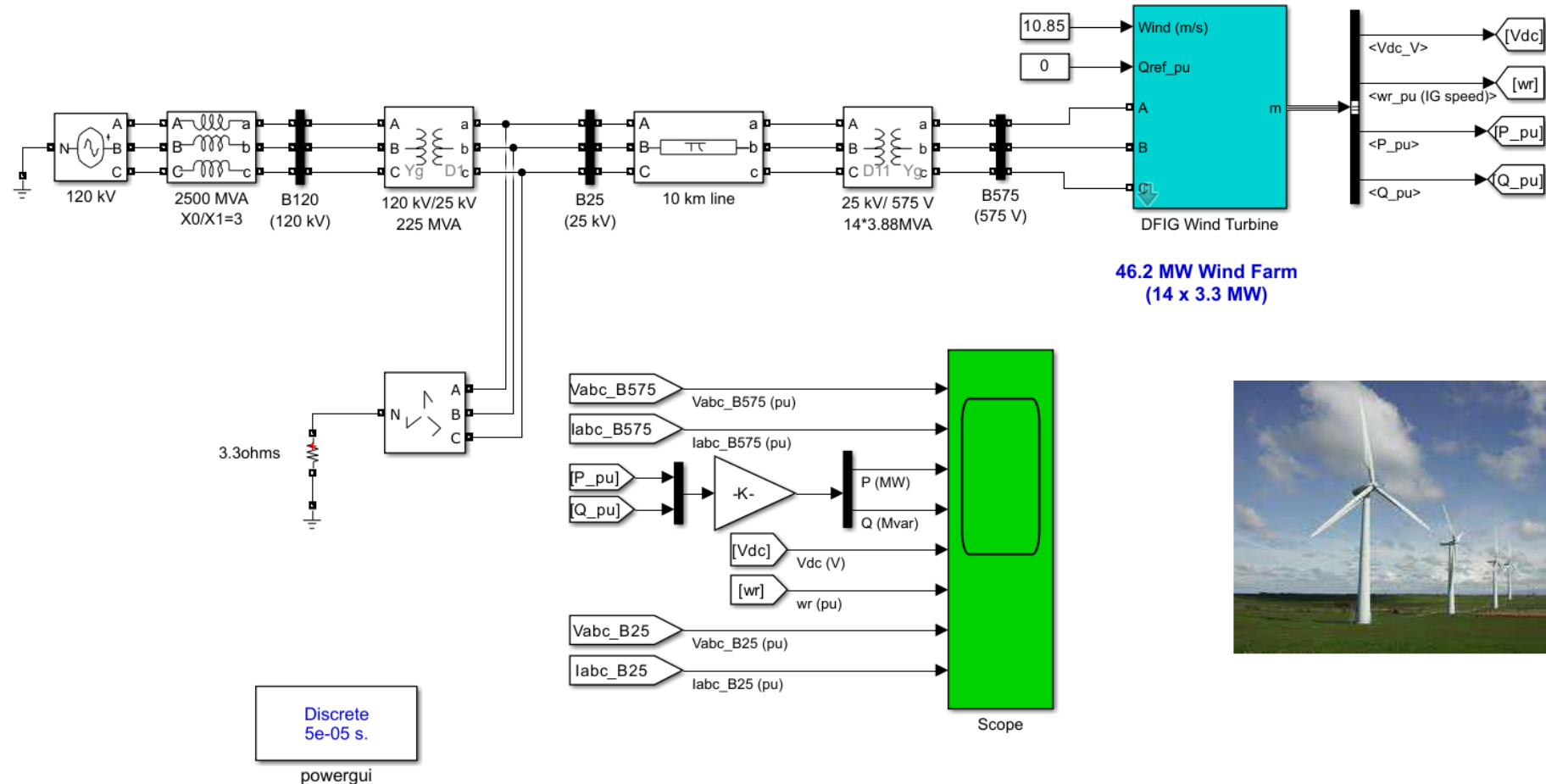
- Easy to adapt / configure
- Simulink
  - Simulink
  - SimPowerSystems
  - Renewable Energy



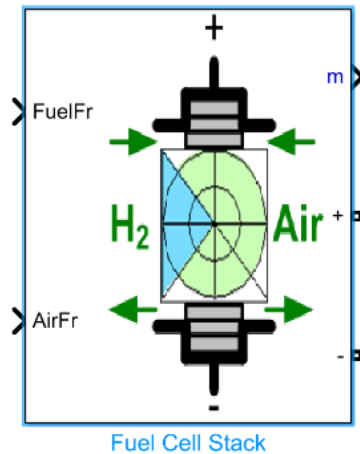
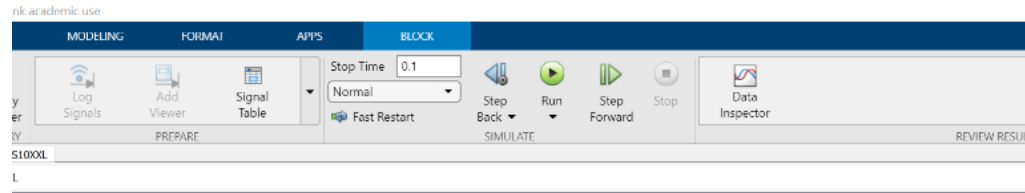
# Experimental Design in Energy Systems



# Experimental Design in Energy Systems



# Experimental Design in Energy Systems



Block Parameters: Fuel Cell Stack

Fuel Cell Stack (mask) (link)

Implements a generic hydrogen fuel cell model which allows the simulation for the following types of cells:

- Proton Exchange Membrane Fuel Cell (PEMFC)
- Solid Oxide Fuel Cell (SOFC)
- Alkaline Fuel Cell (AFC)

Parameters    Signal variation    Fuel Cell Dynamics

Preset model: No (User-Defined)

Model detail Level: Detailed

Voltage at 0A and 1A [V\_0(V), V\_1(V)] [73,68]

Nominal operating point [Inom(A), Vnom(V)] [120,54]

Maximum operating point [Iend(A), Vend(V)] [230,46]

Number of cells: 75

Nominal stack efficiency (%): 55%

Operating temperature (Celsius): 65

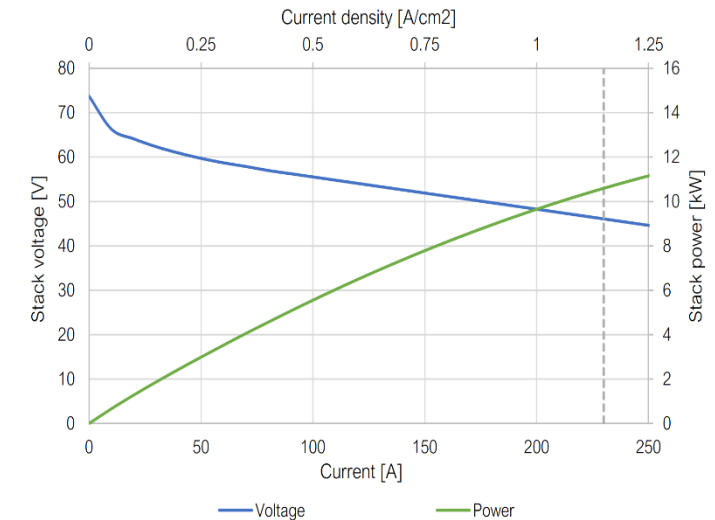
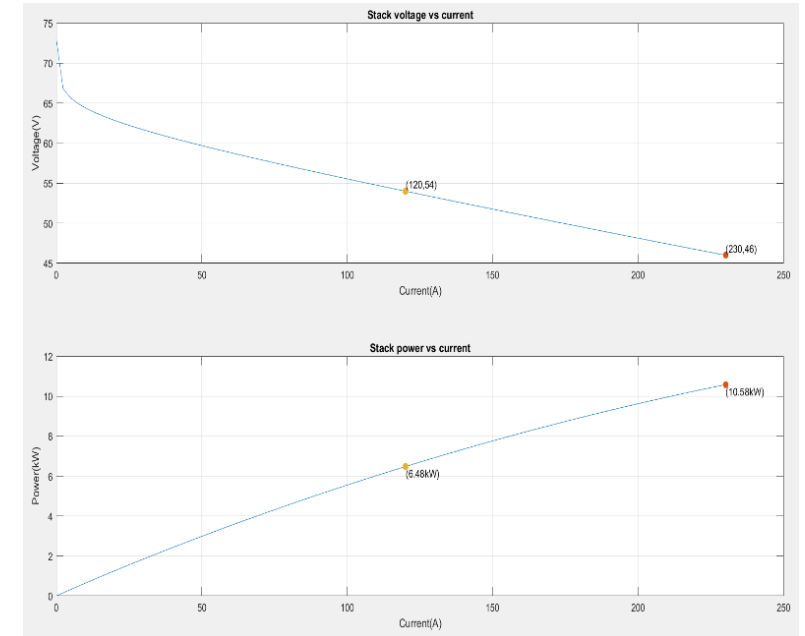
Nominal Air flow rate (lpm): 190

Nominal supply pressure [Fuel (bar), Air (bar)]: [1.5,1]

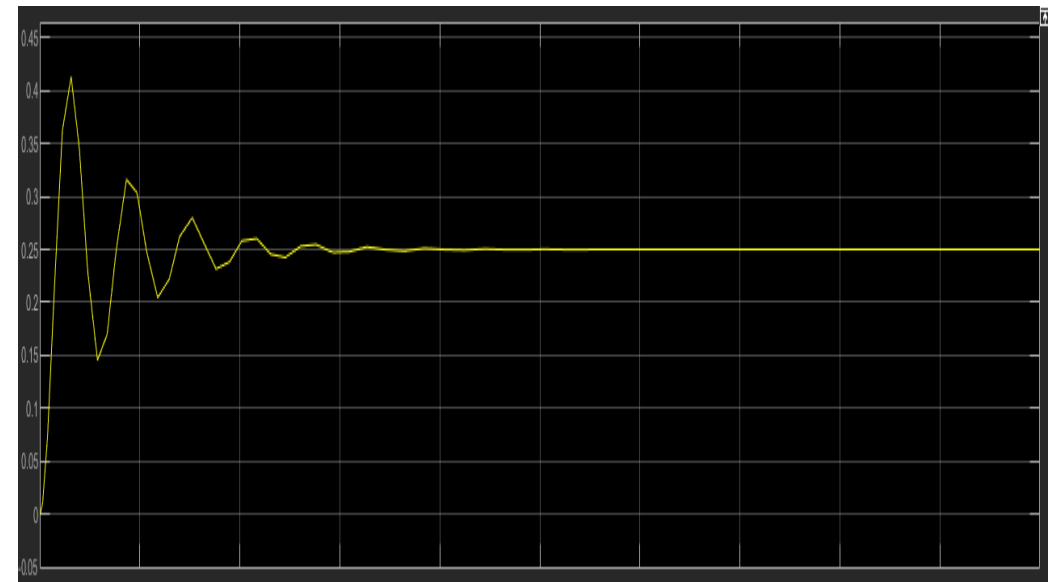
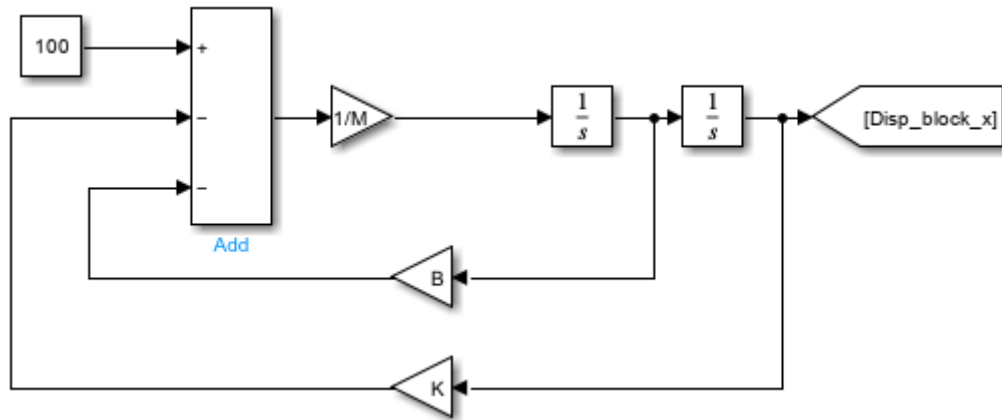
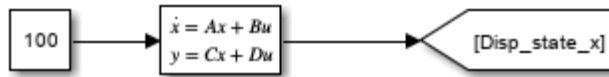
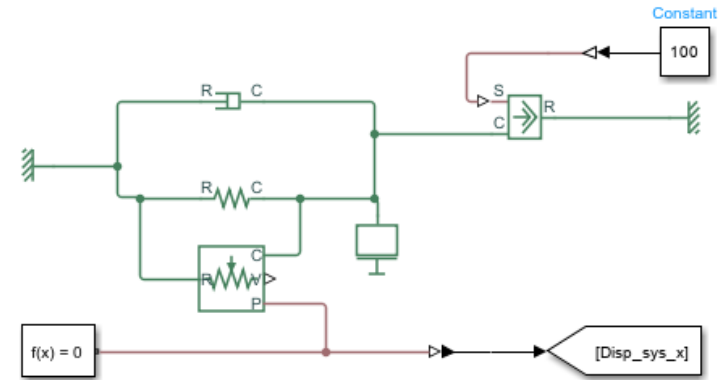
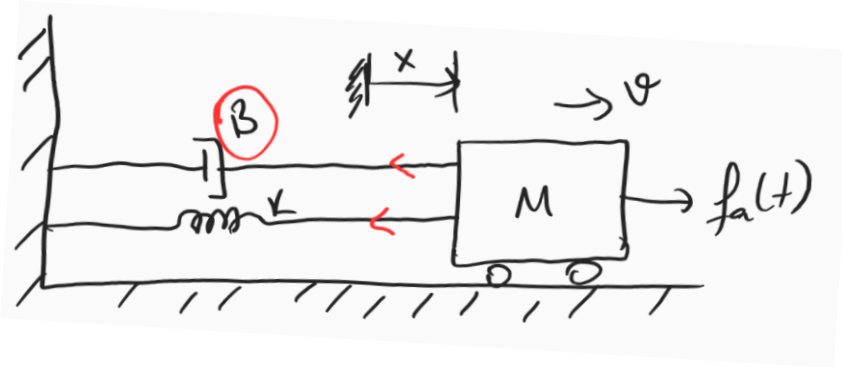
Nominal composition (%) [H2 O2 H2O(Air)]: [99.999,21,1]

Plot V\_I characteristic    View Cell parameters

OK    Cancel    Help    Apply



# Modelling and Analysis of Dynamic Systems



# How MATLAB and Simulink were used in the course

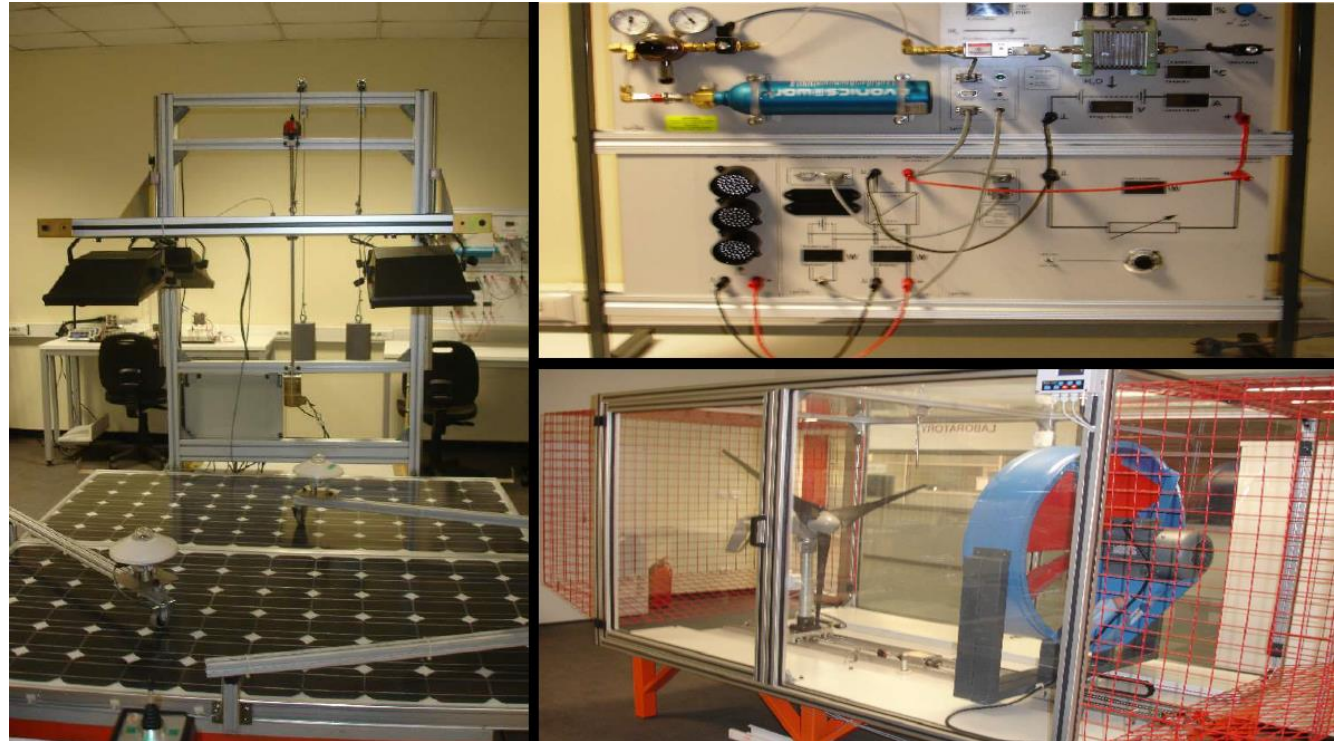
- Education (in class / out of class)
- Homework
- Project
- Experiments vs. simulation



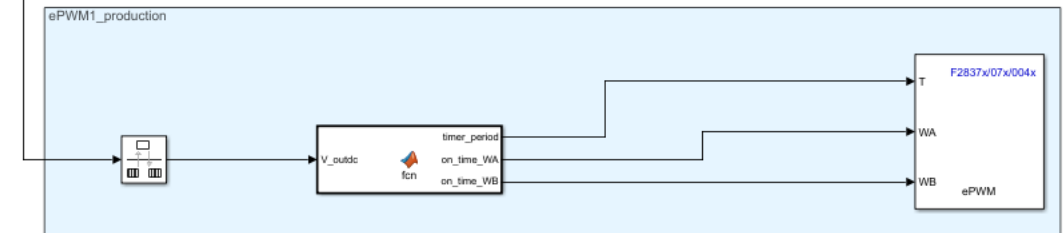
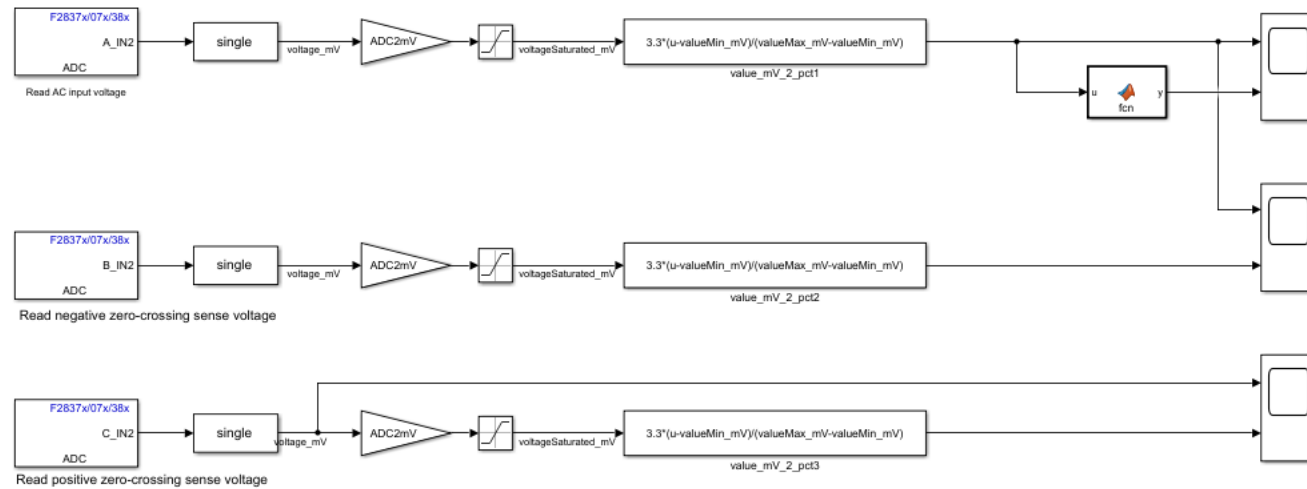
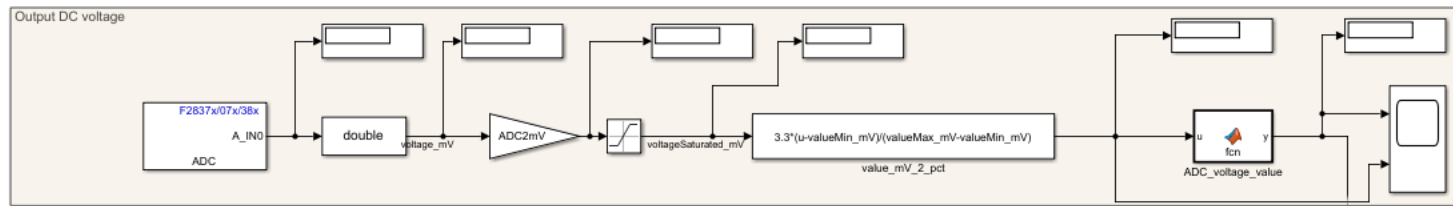
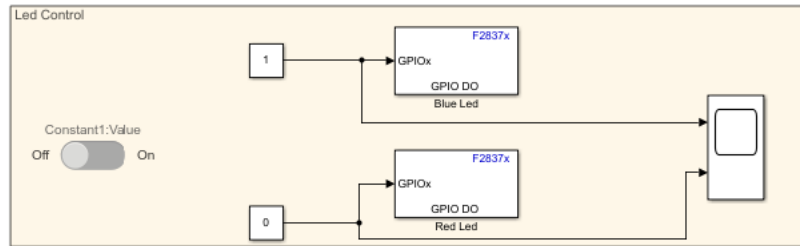
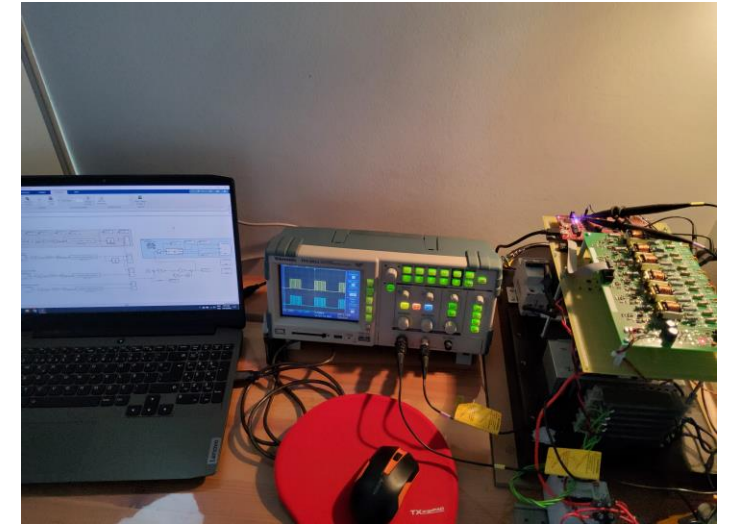


# Benefits of using MATLAB and Simulink

- Experience
- Manageable configuration / step by step design
- Comparison of theory and practice / simulation
- Project based learning



# Results obtained and personal considerations



# Online tools

- Self-paced courses
  - MATLAB Onramp
  - Simulink Onramp
  - Simulink Fundamentals
  - Simscape Onramp
  - Power Electronics Simulation Onramp



Thank you

Q&A – 5min

Asst. Prof. Dr. Nezihe YILDIRAN  
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