TREATY

Course Handbook

Empowering European Universities to Lead Deep Tech Innovation in *Sustainable Energy & Clean Technologies*

Smart and sustainable energy systems

Instructors: Viacheslav Chuba, Ivan Omarov.

Supported by eit Climate-KIC

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EIT HEI Initiative – Innovation Capacity Building for Higher Education – eit-hei.eu

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Course Information

Smart and sustainable energy systems

Instructor(s): Viacheslav Chuba, Ivan Omarov.

ECTS credits: 2

Course structure:	60 hours
Lecture classes	10 hours
Laboratory classes	10 hours
Personal Activities	40 hours

Mode of delivery: hybrid

Course Summary

The course is dedicated to studying the principles of construction, operation, and management of smart and sustainable energy systems. It examines current trends in energy transition, the digitalization of the energy sector, the integration of renewable energy sources, and the reduction of the carbon footprint. Particular attention is paid to Smart Grid, IoT technologies, decentralized generation, increasing energy efficiency, and the sustainable development of energy networks.

Upon completion of the course, students will gain knowledge about the structure and operating principles of smart energy systems, be able to analyze the sustainable development and environmental indicators of energy technologies, apply digital tools for energy resource management, and evaluate the impact of integrating renewable energy sources on system efficiency and reliability.

The competencies gained during the course will enable graduates to work effectively in the field of renewable energy, environmental consulting, energy project management, and contribute to achieving sustainable development goals.

Course Participants

This course is designed for a diverse audience, including both students and specialists who are interested in and wish to deepen their knowledge in the field of Smart Grid, digital technologies, and the sustainable development of energy systems.

Potential participants are:

- ✓ Students at the bachelor's, master's, or doctoral level in engineering, agronomy, or related fields who wish to expand their knowledge of the fundamentals of sustainable energy development, Smart Grid technology, and the use of renewable energy sources;

- ✓ Specialists and practitioners from industry (manufacturing, automation, logistics, energy, etc.) who seek to improve their skills in the application of renewable energy sources and innovations in production;
- ✓ Academic and non-academic staff of research institutes, universities, and companies interested in research on the operation and management of smart and sustainable energy systems.

Prerequisites:

- ✓ A basic understanding of engineering and production systems will be an advantage;
- ✓ In-depth knowledge of engineering is not required; however, participants should be interested in alternative energy sources, sustainable development goals, digitalization, and innovations in the energy sector;
- ✓ The course is open to participants with diverse disciplinary and professional backgrounds, and a readiness to work in an interdisciplinary environment will be an advantage.

Learning Outcomes

Upon completion of the course, participants will be able to:

1) Explain the architecture, functions, and components of the Smart Grid;
2) Analyze the integration of renewable energy sources and its impact on the stability of energy systems;
3) Apply digital and IoT technologies for monitoring and managing energy systems;
4) Perform an energy and environmental assessment of systems;
5) Evaluate the energy efficiency and carbon footprint of energy technologies;
6) Propose engineering solutions based on the principles of sustainable development.

Assessment

In order for each participant to complete successfully the course and be awarded the corresponding ECTS credits, they must pass the course assessment. The outcome of the assessment can be either Pass or Fail.

Assessment methods

- Exam. 30 different topics are offered to assess the obtained by the participants' competencies. The content of the exam work includes: topic importance, description of state-of-the-art level of technologies and modern practical trouble killers, tendencies of development. An exam work must include schemes, formulas, plots, text, etc. Number of words > 500. Provided calculations benefit an exam work. The proper format: A4, 14 pt + Times New Roman.

Assessment Methods	Examples of Assessment
• Explain the architecture, functions, and components	Exam + Oral Presentation

of the Smart Grid;	
• Analyze the integration of renewable energy sources and its impact on the stability of energy systems;	Exam + Oral Presentation
• Apply digital and IoT technologies for monitoring and managing energy systems;	Exam + Report
• Perform an energy and environmental assessment of systems;	Exam + Report
• Evaluate the energy efficiency and carbon footprint of energy technologies;	Exam + Oral Presentation
• Propose engineering solutions based on the principles of sustainable development.	Exam + Quiz

Mentoring

As part of the course, participants will receive individual mentoring during the completion of their assignment/project, or gain practical experience related to Smart Grid modeling, RES potential assessment, development of IoT solutions for energy resource monitoring, or assessment of the sustainability of energy systems.

Depending on their experience and interests, they may focus on areas such as:

- ✓ Integration of RES into distribution networks;
- ✓ Implementation of digital and IoT technologies in modern energy systems;
- ✓ Research based on modeling energy flows in sustainable energy systems;
- ✓ Research based on determining the potential for implementing bioenergy technologies;
- ✓ Evaluation of energy efficiency and environmental indicators of modern energy systems;

This mentoring component ensures that each participant develops practical competencies while adapting the learning outcomes to their individual professional or academic goals.

Bibliography

1. Buchholz, B. M., & Styczynski, Z. A. (2020). *Smart Grids – Fundamentals and Technologies in Electric Power Systems of the Future*. Springer. SpringerLink
2. Buchholz, B. M., & Styczynski, Z. A. (2014). *Smart Grids – Fundamentals and Technologies in Electricity Networks* (1st ed.). Springer. SpringerLink
3. Salkuti, S. R. (Ed.). (2024). *Energy and Environmental Aspects of Emerging Technologies for Smart Grid*. Springer. SpringerLink
4. Singh, R., & others. (2021). *Advances in Smart Grid Power System: Network, Control and Security*. Elsevier/O'Reilly. O'Reilly Online Library
5. Rezaei, M., et al. (2020). *A Comprehensive Review of Recent Advances in Smart Grids: A Sustainable Future with Renewable Energy Resources. Energies*, 13(23), 6269. MDPI
6. Aalamifar, F., et al. (2022). *Smart grid (SG) properties and challenges: an overview. Discover Energy*. SpringerLink
7. Wang, X., et al. (2023). *Control and Optimisation of Power Grids Using Smart Meter Data: A Review. Sensors*. PMC

8. IJERT (2021). *Smart Grid: The Future of the Electric Energy System. International Journal of Engineering Research & Technology (IJERT).* ijert.org

Other Important Information

Course evaluation: Upon successful completion of the course, participants are required to fill in the course evaluation questionnaire.

Certificate: Upon successful completion of the course, participants will be issued a certificate of achievement provided by The Cyprus Institute and EIT Climate KIC.

Plagiarism: CyI has explicit rules concerning academic dishonesty including plagiarism. Course participants are reminded that all work submitted as part of the requirements for any examination (including coursework) of CyI must be expressed in their own words and incorporated in their own ideas and judgements.

Course Timetable

Session	Date and Time	Instructor	Venue
1st	November 3th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
2nd	November 4th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
3rd	November 5th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
4th	November 6th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
5th	November 7th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
6th	November 10th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
7th	November 11th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
8th	November 12th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
9th	November 13th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5
10th	November 14th, 14.00-15.20	Viacheslav Chuba, Ivan Omarov	Auditorium 137G, Campus 5

Contact Details of Instructor(s)

Name	Email	Telephone number
Viacheslav Chuba	vvchuba@ukr.net	+380961332665
Ivan Omarov	omarov.ivan@gmail.com	+380504630361

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