EUROPEAN UNIVERSITY FOR CUSTOMISED EDUCATION

STUDY GUIDE

Integrated Energy Systems - Challenges for a Sustainable World Summer School

Organised by

University of Vaasa (UVA)
University of Cantabria (UC)

1. IDENTIFYING DATA.	
· Course Name	Integrated Energy Systems. Challenges for a Sustainable World Summer School
· Coordinating University	University of Vaasa (UVA) University of Cantabria (UC)
· Host University	University of Cantabria (UC)
· EUNICE Partner Universities	Poznan University of Technology (PUT), University of Mons (UMONS), Université Polytechnique Hauts-de-France (UPHF)
· Course Field(s)	Integrated Energy Systems
· Related Study Program	The Summer School is designed for students in Schools or Departments of Electrical or Mechanical Engineering, Production Engineering, Energy Engineering, Sciences and Technology degrees related to: (1) Materials and Recycling for Energy, (2) Advanced Energy Infrastructure, (3) Electronics and Power Conversion, and (4) Smart Grid and Data Analytics
· ISCED Code	ISCED 8 (PhD) ISCED 7 (Master level) ISCED 6 (Bachelors, see Study Level below)
· SDG	SDG 7. Affordable and Clean Energy SDG 9. Industry Innovation and Infrastructure SDG 13. Climate Action
· Study Level	Ph.D., Master, plus last year Bachelor doing their final thesis on the topic of the Summer School
· Number of ECTS credits allocated	3 ECTS
· Mode of Delivery	Erasmus+ Blended Intensive Programme (BIP), i.e. a virtual component + physical mobility
· Language of Instruction	English
· Delivery Period	Summer 2024
· Course Dates	· Virtual component: 6 May to 30 May, 2024 · Physical Attendance: 24 to 28 June, 2024
· Precise Schedule of the Lectures	· Virtual component: 6/May to 30/May 2024 · Physical Attendance, 24 to 28 June, 9:30am – 14:00pm GMT+1, with cultural required activities after class
· Key Words	low carbon footprint, renewable energy, energy storage, hydrogen power, alternative sources of energy, diversification of energy sources, climate policy goals, energy infrastructure, durable materials, smart-grid, power electronics interfaces, engineering
· Prerequisites and co-requisites	· EUNICE Student · English B2

	· Ph.D. or Master's student in one of the areas in electrical engineering, mechanical engineering, energy engineering, environmental, engineering, science and technology or similar · Last year Bachelor student doing their final thesis on any of the aforementioned topics
· Number of EUNICE students that can attend the Course	20
· Course inscription procedure(s)	· UC students: enrol through Virtual Campus · Students from EUNICE universities: contact your International Relations Office (IRO)
· Applications Deadline	· Each IRO establishes their own internal call · DEADLINE: 21 March, 2024- IROs send UC's IRO the nominations

2. CONTACT DETAILS.	
· Responsible Lecturer	Marcelo Godoy Simões (UVA)
· E-mail	marcelo.godoy.simoes@uwasa.fi
· Other Lecturers	Mohammed Elmusrati (UVA) Raquel Martínez Torre (UC) Pablo Bernadro Castro Alonso (UC) Alberto Laso Pérez (UC) Mario Mañana Canteli (UC) Elhadj Dogheche (UPHF) Denis Remiens (UPHF) Marie Lasgorceix (UPHF) Mohammed Rguiti (UPHF) Zacharie De Greve (UMONS) Francois Vallée (UMONS) Rafal Slefarski (PUT) Pawel Czyzewski. (PUT)

3. OBJECTIVES.

The Summer School "Integrated Energy Systems - Challenges for a Sustainable World" brings together core capabilities and strengths from multidisciplinary areas to improve advance of renewable energy sources in our utility grid, decreasing the cost of such technologies and accelerating the digitization of our economy through emerging technologies in solar energy, wind energy, energy storage technologies, marine energy, heat pumps, electric vehicles, hydrogen, and biomass. This program has significance in making possible the strengthening and impact of the international attraction of research, education, and innovation to the whole society. The future electric grid will be smart, with user-interaction, bidirectional power flow, multiple distributed

energy sources with high-tech dynamics and controls. Students at this Summer School will learn about:

- Electronics and Power Conversion: combined power system and power electronics approach, where enabled renewable energy systems will interact with the utility grid,
- Smart Grids and Data Analytics: establishing microgrids with intelligence and data analytics approaching a Smart-Grid, optimal operation and sizing of Energy Community systems
- Materials and Recycling for Energy
- Advanced Energy Infrastructure and Technologies: grid integration of renewable energy sources, alternative fuels, power quality, green gas technologies, fundamentals of adequacy in modern power systems

The program aims to contribute to the education of the leaders for this 21st century energy technologies.

4. LEARNING OUTCOMES.

The energy sector plays a leading role, because there are important challenges for humanity to solve intertwined by climate change, energy lack for disadvantaged people, economic and social sustainability. This Summer School embraces such a multidisciplinary approach, to prepare students to play a relevant role in social transformation, while developing professionally. This Summer School is blended and multifaceted: there is an Online module for building up a Community of Practice and having a established cohort of integrated students and teachers, for a Face-To-Face one week full and intensive daily activities of several modules, with classes, learning and cultural activities as well. The modules developed by the five partners will be aligned with four areas : (1) Materials and Recycling for Energy, (2) Advanced Energy Infrastructure, (3) Electronics and Power Conversion, and (4) SmartGrid and Data Analytics.

- The student will gain an understanding of the fundamentals of energy production (renewable electricity, alternative fuels, green gas, etc.) and conversion (power electronics) technologies.
- The student will learn basics on how to integrate these technologies together in a single energy system, using techniques such as Machine Learning and Operations Research
- The student will learn how intermittent renewable energy sources impact the operation of an electricity grid (power quality, adequacy, etc.)
- The student will understand the critical role of Materials for a successful energy transition (recycling, processes, etc.)
- The students will gain experience of working in teams, in a multi-cultural and multidisciplinary environment.

Students who conclude this Summer School will be better prepared for their research thesis work as well as to apply for industrial internships with teams in energy, also further their bridge between academical knowledge making potential increase of their social impact.

5. COURSE ORGANISATION.

COURSE SYLLABUS.

1.	**Optimal Operation and Sizing of Renewable Energy Communities.** Zacharie De Greve
2.	**Adequacy Studies in Modern Power Systems.** Francois Vallée
3.	**Digital Control for Power Electronics.** Marcelo Godoy Simões
4.	**AI and ML in Power Electronics and Power Systems.** Marcelo G. Simões & Mohammed Elmusrati
5.	**Grid-Integration of Renewable Energies.** Raquel Martínez Torre & Pablo B. Castro Alonso
6.	**Power Quality Impact of Renewables in Power Systems.** Mario Mañana Canteli &Alberto L.Pérez
7.	**Alternative Fuels**. Rafal Slefarski
8.	**Green Gas Technologies in IES.** Pawel Czyzewski
9.	**Recycling Materials from Energy Systems.** Elhadj Dogheche
10.	**Materials, Processes and Performances.** Denis Remiens, Marie Lasgorceix & Mohammed Rguiti

LEARNING RESOURCES AND TOOLS.

Learning resources and tools will be uploaded to EUNICE Moodle Platform in advance.

PLANNED LEARNING ACTIVITIES AND TEACHING METHODS.

The training activities will be of a theoretical or practice nature. The teaching methodology will be active, seeking the participation of students with the teachers as well as in groups.

The course will be developed using the EUNICE Moodle Platform. On this platform students will find presentations, lectures, notes, assessments, activities and any compulsory readings corresponding to each module.

6. ASSESSMENT METHODS AND CRITERIA.

· ONLINE (mandatory): asynchronous online studies, to be delivered by all partner universities where students will work in pairs or groups. The online module is an icebreaker prior to the social and cultural dimension of the experience in Spain. Students will interact and know each other, to get prepared with some foundations for the courses. The overall framework must be such that each individual work with everyone else of the whole group, making a cohesive cohort, before they arrive in June for the physical attendance of the 5 days in UC.

· Face-to-Face courses: each university will present their modules in each day (as described in the Course Syllabus above) establishing their theoretical foundations. Each instructor will have their own assessment, it could be Q&A, written and or oral presentation in groups, or any acceptable measurement of achievement of learning outcomes in a module per module basis. The cultural and social activities during the 5-days face-to-face in June will be an integral part for the whole 3 ECTS Summer School.

7. BIBLIOGRAPHY AND TEACHING MATERIALS.

Bibliography and teaching materials will be uploaded to EUNICE Moodle Platform prior to the start of the course. The EUNICE Moodle Platform will aggregate all above courses and modules conducted for Online + Face-to-Face and clear assessment, ranking and grading will be available for each student to check their performance and successful completion of all activities.