unite! | University Network for Innovation, Technology and Engineering

# VECP Energy

## Courses offered
## spring semester 2024

TECHNISCHE UNIVERSITÄT DARMSTADT | Aalto University | TU Graz Graz University of Technology | Grenoble INP UGA | KTH | Politecnico di Torino | U LISBOA Universidade de Lisboa | Universitat Politècnica de Catalunya BarcelonaTech | Wrocław University of Science and Technology

# Content

# VECP Energy - Overview of courses offered

When reading the course information below, please pay attention to the different academic calendars, day and hour of the course and the course requirements. If you have questions on whether the course fits your study plan, please contact your professors or an academic advisor at your home institution.

| University | Lecturer | Course Name | Credits | Time Frame | N. of available positions for U! students |
|---|---|---|---|---|---|
| KTH | Prof. Viktoria Martin | Introduction to Energy Systems Analysis and Applications - Minor Course | 6 | 2024.01.16 - 2024.06.03 | 16 |
| KTH | Prof Andrew Martin | Numerical Heat Transfer in Energy Technology 3.0 | 3 | 2024.03.18 - 2024.06.03 | 16 |
| KTH | Associate Prof Samer Sawalha | Heating, Cooling and Indoor Climate | 6 | 2024.01.16 - 2024.06.03 | 16 |
| Aalto | Kari Alanne | Sustainable Building Energy Systems | 5 | 23.4.2024–29.5.2024 | 16 |
| Aalto | Annukka Santasalo-Aarnio | AAE-E3071 Electrical Energy Storage System Theory | 3 | 9.1.2024 – 25.2.2024 | 5 |
| Aalto | Peter Lund | Advances in New Energy Technologies D | 5 | 10.1.2024–7.6.2024 | Unlimited |
| TU Graz | Wogrin Sonja | Fundamentals of Electricity Economics | 3 | 04.03.2024 – 27.06.2024 | 20 |
| ULisbon - IST | Professor Ricardo Pereira | Offshore Wind Energy | 6 | 14.02.2024 – 30.06.2024 | 8 |
| ULisbon - IST | Professor Luís Gato | Wave Energy | 6 | 14.02.2024 – 30.06.2024 | 8 |
| ULisbon - IST | Professor João Carlos Henriques | Marine Current and Tidal Energy | 6 | 14.02.2024 – 30.06.2024 | 8 |
| ULisbon - IST | Professor Luís Gato | Project in Marine Renewable Energies | 6 | 14.02.2024 – 30.06.2024 | 8 |
| ULisbon - IST | Professor Luís Gato | Renewable Energies | 6 | 15.04.2024 – 30.06.2024 | 8 |

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|---|---|---|---|---|---|
| TU Darmstadt | Prof. Dr.-Ing. Gerd Griepentrog | Control of Drives | 5 | 15/04/2024-19/07/2024 (planned for Tuesday 09:50 to 11:30 am and Friday, 08:00 to 09:40 am) | 16 |
| TU Darmstadt | Prof. Dr. rer. nat. Markus Roth | Energy from Nuclear Fusion | 5 | 15/04/2024-19/07/2024 (planned for Monday 09:50 to 11:30 am and Thursday, 09:50 to 10:40 am) | 8 |

Workload/ Prerequisites/ Course Literature: For the courses listed above please consult both the detailed course description and web link. Some courses have special prerequisites, please check the weblinks which provide information about literature required and further assessment guidelines and exams. Please contact the course professors if you require more information.

# Application Information

Students apply at the home institution until **November 13th** for courses in spring/summer 2024. **A maximum of two courses can be selected at one of the partner universities.**

- Application information for students from Aalto University
- Application information for students from Grenoble INP-UGA
- Application information for students from KTH
- Application information for students from Politecnico di Torino
- Application information for students from TU Darmstadt
- Application information for students from TU Graz
- Application information for students from ULisbon
- Application information for students from UPC
- Application information for students from Wroclaw Tech

The applications will be processed at the home institution and the students will be nominated to the host institution. You will receive information about the second application to be filled-in at the host institution in November/December. After successful application at the host institution, you will be enrolled at the host institution. You will have to register for the selected courses before the semester starts.

# Detailed List of Courses offered

| | |
|---|---|
| **University**<br>KTH | **Country**<br>Sweden |
| **Course title**<br>Introduction to Energy Systems Analysis and Applications - Minor Course | |
| Faculty | |
| Credits | 6 |
| Level | master/second cycle |
| Content | The overall objective of this course is to provide the student with solid ground knowledge of Energy Systems Modelling theory and its application to problems of sustainable development planning. This includes the creation from scratch and understanding of an energy system model and its underlying dynamics. |
| Specific requirements for participation | Bachelor of Science in Technology. Knowledge of sustainable development and system analysis corresponding content in courses MJ2413 "Energy and Environment" or MJ2508 "Energy Systems for Sustainable Development. Knowledge of Linear Algebra, corresponding content in course SF1624 "Algebra and Geometry" |
| Course dates | 2024.01.16 - 2024.06.03 |
| Synchronous / Asynchronous | Synchronous |
| Exam format | PROA - Project A, 1.5 credits, grading scale: A, B, C, D, E, FX, F, PROB - Project B, 1.5 credits, grading scale: A, B, C, D, E, FX, F, PROC - Group project, 3.0 credits, grading scale: A, B, C, D, E, FX, F |
| N. of available positions for U! students | 16 |
| **Course supervisor (name)**<br>Prof. Viktoria Martin | **Contact (Mail)**<br>viktoria.martin@energy.kth.se |
| Additional information/Weblink | KTH \| MJ2381 |

| **University**<br>KTH | **Country**<br>Sweden |
|---|---|
| **Course title**<br>Numerical Heat Transfer in Energy Technology 3.0 | |
| Faculty | |
| Credits | 3 |
| Level | master/second cycle |
| Content | The general aim of the course is to give a solid background about numerical methods that are relevant to heat transfer and flow for applications in the energy field with an emphasis on design of components. Participants that complete the course will have sufficient prior knowledge for following studies where commercial numerical calculation tools (CFD codes) are used. |
| Specific requirements for participation | Documented knowledge in the following subjects: Heat transfer, 6 credits, equivalent to contents of MJ1401; Fluid mechanics, 6 credits, equivalent to contents of SG1220; programming in Matlab, Python or the like |
| Course dates | 2024.03.18 - 2024.06.03 |
| Synchronous / Asynchronous | Synchronous |
| Exam format | INLA - Home assignment, 0.5 credits, grading scale: P, F INLB - Home assignment, 0.5 credits, grading scale: P, F TEN1 - Written exam, 2.0 credits, grading scale: A, B, C, D, E, FX, F |
| N. of available positions for U! students | 16 |
| **Course supervisor (name)**<br>Prof Andrew Martin | **Contact (Mail)**<br>andrew.martin@energy.kth.se |
| Additional information/Weblink | KTH \| MJ2515 |

| **University**<br>KTH | **Country**<br>Sweden |
|---|---|
| **Course title**<br>Heating, Cooling and Indoor Climate | |
| Faculty | |
| Credits | 6 |
| Level | master/second cycle |
| Content | Various types of buildings and their energy use. Conventional heating and cooling system in buildings. Current and new technology for heat and cold. Concepts and design details for heat pumping technology (steam compression systems). Components for heat pump systems. Simulation tools for cold and heat calculations in buildings. Calculation tools for heating and cooling system. Analysis of energy performance for heating and cooling systems in buildings. |
| Specific requirements for participation | Bachelor degree in mechanical engineering. Preferrably with knowledge in applied thermodynamics (example MJ1112, 9 credits) and heat transfer (example MJ1401, 6 credits). |
| Course dates | 2024.01.16 - 2024.06.03 |
| Synchronous / Asynchronous | Synchronous |
| Exam format | INL1 - Written Assignment, 1.5 credits, grading scale: P, F |
| N. of available positions for U! students | 16 |
| **Course supervisor (name)**<br>Associate Prof Samer Sawalha | **Contact (Mail)**<br>samer.sawalha@energy.kth.se |
| Additional information/Weblink | https://www.kth.se/student/kurser/kurs/MJ2443?l=en |

| **University**<br>Aalto | **Country**<br>Finland |
|---|---|
| **Course title**<br>Sustainable Building Energy Systems | |
| Faculty | Department of Mechanical Engineering |
| Credits | 5 |
| Level | master/second cycle |
| Content | After passing the course the student: knows the key energy consumers in the building s energy balance, knows the basic terminology and definitions related to (nearly) net-zero energy buildings, plus energy buildings and hybrid smart grids, understands the principles of on-site energy generation, grid interaction and energy matching, knows the key sustainable building envelope components, advanced energy storage and HVAC systems, knows the key technologies and systems for the utilization of renewable energy, understands the relationship between the temperature of the heat source, exergy and the Carnot efficiency in the context of building energy systems (the concept of energy quality). |
| Specific requirements for participation | Knowledge of heating/cooling systems and ventilation and air-conditioning systems |
| Course dates | 23.4.2024–29.5.2024 |
| Synchronous / Asynchronous | Synchronous |
| Exam format | LAB1 - Laboratory Lessons, 1.5 credits, grading scale: P, F |
| N. of available positions for U! students | 5 |
| **Course supervisor (name)**<br>Kari Alanne | **Contact (Mail)**<br>kari.alanne@aalto.fi |
| Additional information/Weblink | Summary of AAE-E4005 - Sustainable Building Energy Systems, Lecture, 25.4.2023-31.5.2023 (aalto.fi)<br>Tip: via Guest access you can see the information |

| **University**<br>Aalto | **Country**<br>Finland |
|---|---|
| **Course title**<br>AAE-E3071 Electrical Energy Storage System Theory | |
| Faculty | Department of Electrical Engineering and Automation 50 %<br><br>Department of Mechanical Engineering 50 % |
| Credits | 3 |
| Level | master/second cycle |
| Content | This is a joint course from School of Engineering and School of Electrical Engineering to study closely the interfaces of electrical production and consumption systems and energy storages. This course is very multidisciplinary and will invite students from different backgrounds jointly applying their knowledge on electricity storage cases. |
| Specific requirements for participation | No previous knowledge of energy storage systems or circular economy is needed (but it would be a good background). |
| Course dates | 9.1.2024 – 25.2.2024 |
| Synchronous / Asynchronous | Asynchronous |
| Exam format | TEN1 - Written Exam, 3.0 credits, grading scale: A, B, C, D, E, FX, F |
| N. of available positions for U! students | 16 |
| **Course supervisor (name)**<br>Annukka Santasalo-Aarnio | **Contact (Mail)**<br>annukka.santasalo@aalto.fi |
| Additional information/Weblink | Course: AAE-E3071 - Electrical Energy Storage Systems Theory D, Lectures, 12.6.2023-1.9.2023 (aalto.fi) |

| **University**<br>Aalto | **Country**<br>Finland |
|---|---|
| **Course title**<br>Advances in New Energy Technologies D | |
| Faculty | Department of Applied Physics |
| Credits | 5 |
| Level | master/second cycle |
| Content | After completing this course the student will have knowledge of: new technologies and systems for energy, spatial and temporal variations in energy, principles of power systems and integration, energy chain analysis, basic flexibility strategies, advanced flexibility strategies and basics of energy storage. |
| Specific requirements for participation | The course is intended to master's students with a basic knowledge in science or engineering. Basic understanding of renewable energy technologies. |
| Course dates | 10.1.2024–7.6.2024 |
| Synchronous / Asynchronous | Synchronous |
| Exam format | Project work and an exam, grading scale from 1-5 |
| N. of available positions for U! students | unlimited |
| **Course supervisor (name)**<br>Peter Lund | **Contact (Mail)**<br>peter.lund@aalto.fi |
| Additional information/Weblink | Course: PHYS-E0483 - Advances in New Energy Technologies D, Lecture, 12.1.2022-12.4.2022 (aalto.fi) |

| **University**<br>TU Graz | **Country**<br>Austria |
|---|---|
| **Course title**<br>Fundamentals of Electricity Economics | |
| Faculty | Electrical and Information Engineering |
| Credits | 3 |
| Level | Undergraduate |
| Content | In the course, we focus on the following topics:<br>1. Introduction to mathematical modeling and optimization for problems in electricity economics<br>a. Formulate and solve problems related to the electricity industry (linear programming, mixed integer programming)<br>b. Standard problems in electricity economics (economic dispatch, transport, unit commitment)<br>c. Duality and economic interpretation<br>d. Simulation models in electricity economics (description and practical use)<br>2. Special features of the electricity industry and electricity economics<br>a. Liberalization of the electricity markets (Austria, Europe) and regulatory tasks<br>b. Electricity markets/electricity trading (OTC; spot and futures markets; exchanges, etc.))<br>c. Development and structure of electricity prices (energy costs, grid usage prices, system services)<br>d. Influence of the energy transition on the electricity industry and economis |
| Specific requirements for participation | Interest in electricity economics, no special requirements.<br><br>No German skills required. If there are students who don't speak German, the course will be held in English. |
| Course dates | 04.03.2024 – 27.06. 2024, regular class: Mondays from 08:15 - 09:45 |
| Synchronous / Asynchronous | Synchronous |
| Exam format | written exam |
| N. of available positions for U! students | 20 |
| **Course supervisor (name)**<br>Wogrin Sonja | **Contact (Mail)**<br>wogrin@tugraz.at |
| Additional information/Weblink | Course Description |

| **University**<br>ULisbon - IST | **Country**<br>Portugal |
|---|---|
| **Course title**<br>Offshore Wind Energy | |
| Faculty | IST Técnico Lisboa |
| Credits | 6 |
| Level | MSc |
| Content | After the completion of the course, the student will become familiar with:<br>• fundamentals of aerodynamic theory for wind turbines<br>• numerical modelling and control simulation of wind turbines<br>• the nature of the wind energy resource offshore and the differences to the wind energy resource onshore<br>• linear wave theory<br>• the hydrodynamic stability and dynamics of offshore wind floating foundations (OWFF)<br>• mooring systems and anchor types<br>• estimations of wind, wave and current loads on fixed and floating offshore structures<br>• laboratory procedures for testing OWFFs<br>https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/845953938490326 |
| Specific requirements for participation | Basic programming skills, fluid mechanics |
| Course dates | 14.2.2024 – 30.6.2024 |
| Synchronous / Asynchronous | |
| Exam format | |
| N. of available positions for U! students | 8 |
| **Course supervisor (name)**<br>Professor Ricardo Pereira | **Contact (Mail)**<br>ricardosantospereira@tecnico.ulisboa.pt |
| Additional information/Weblink | https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/845953938490326 |

| **University**<br>ULisbon - IST | **Country**<br>Portugal |
|---|---|
| **Course title**<br>Wave Energy | |
| Faculty | IST Técnico Lisboa |
| Credits | 6 |
| Level | MSc |
| Content | After completing the course the students should:<br>• be familiar with the linear hydrodynamic theory of surface waves and its application to wave energy systems<br>• have basic knowledge of hydrodynamic modeling and control of wave energy systems<br>• have introductory knowledge of ocean energy system testing and monitoring techniques<br>• be familiar with the state of the art of electro-mechanical equipment for wave energy conversion<br>• acquired basic knowledge related to mooring and anchoring systems<br>• be familiar with the design principles of ocean energy arrays.<br><br>https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/283003985068474 |
| Specific requirements for participation | |
| Course dates | 14.2.2024 - 30.6.2024 |
| Synchronous / Asynchronous | |
| Exam format | |
| N. of available positions for U! students | 8 |
| **Course supervisor (name)**<br>Professor Luís Gato | **Contact (Mail)**<br>luis.gato@tecnico.ulisboa.pt |
| Additional information/Weblink | https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/283003985068474 |

| **University**<br>ULisbon - IST | **Country**<br>Portugal |
|---|---|
| **Course title**<br>Marine Current and Tidal Energy | |
| Faculty | IST Técnico Lisboa |
| Credits | 6 |
| Level | MSc |
| Content | At the completion of the course, the student will become familiar with:<br>• currents, tides and their characteristics<br>• tidal barrages, tidal streams and lagoons<br>• resource assessment<br>• hydrodynamic theory of marine current turbines (BEM, lifting line and panel methods)<br>• advanced hydrodynamic modelling and control of MC&TE systems<br>• experimental testing and monitoring of current energy systems<br>• the state of the art of electro-mechanical power take-off equipment used in current energy converters<br>• mooring and anchoring systems<br>• design principles and configuration of farms<br>• experimental methodologies for turbine testing<br>https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/1690378868621636 |
| Specific requirements for participation | |
| Course dates | 14.2.2024 - 30.6.2024 |
| Synchronous / Asynchronous | |
| Exam format | |
| N. of available positions for U! students | 8 |
| **Course supervisor (name)**<br>Professor João Carlos Henriques | **Contact (Mail)**<br>joaochenriques@tecnico.ulisboa.pt |
| Additional information/Weblink | https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/1690378868621636 |

| **University**<br>ULisbon - IST | **Country**<br>Portugal |
|---|---|
| **Course title**<br>Project in Marine Renewable Energies | |
| Faculty | IST Técnico Lisboa |
| Credits | 6 |
| Level | MSc |
| Content | The objective of this curricular unit is to provide the students with the background and methodologies of multidisciplinary aspects associated with the various marine renewable energy technologies and bring into practice the specialised knowledge on marine energies in a case study. The objective will be achieved through formal lectures, tutorials and a project.<br><br>https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/845953938490325 |
| Specific requirements for participation | |
| Course dates | 14.2.2024 - 30.6.2024 |
| Synchronous / Asynchronous | |
| Exam format | |
| N. of available positions for U! students | 8 |
| **Course supervisor (name)**<br><br>Professor Luís Gato | **Contact (Mail)**<br><br>luis.gato@tecnico.ulisboa.pt |
| Additional information/Weblink | https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/845953938490325 |

| **University**<br>ULisbon - IST | **Country**<br>Portugal |
|---|---|
| **Course title**<br>Renewable Energies | |
| Faculty | IST Técnico Lisboa |
| Credits | 6 |
| Level | MSc |
| Content | The course aims to provide students with general knowledge about Renewable Energy. The program is multidisciplinary and covers physical principles and technologies. The curriculum focuses on electric energy production, biofuels and thermal applications. The course includes two main areas:<br>• Fundamentals: physical laws and the renewable energy conversion chain.<br>• Technology: the main technologies in the renewable energy sector.<br><br>Upon completion of the course, students will be able to:<br>• Understand the renewable energy sector from different perspectives.<br>• •Understand the scientific fundamentals and engineering design principles of renewable energy systems.<br>• Evaluate and compare different renewable energy technologies.<br><br>https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/283003985068480 |
| Specific requirements for participation | |
| Course dates | 20Fev/30June |
| Synchronous / Asynchronous | |
| Exam format | |
| N. of available positions for U! students | 8 |
| **Course supervisor (name)**<br><br>Professor Luís Gato | **Contact (Mail)**<br><br>luis.gato@tecnico.ulisboa.pt |
| Additional information/Weblink | https://fenix.tecnico.ulisboa.pt/cursos/mege/disciplina-curricular/283003985068480 |

| **University**<br>TU Darmstadt | **Country**<br>Germany |
|---|---|
| **Course title**<br>Control of Drives | |
| Faculty | Electrical Engineering - Power Electronics and Control of Drives |
| Credits | 5 |
| Level | Master |
| Content | The lecture is structured into three main parts:<br>The first part is an introduction and deals with control structures for drive systems, the tuning of drive controls and inverters for controlled drives. Chapter 3 dealing with space vectors can also be regarded as an introduction, as the models of the ac-machines are based upon space vectors. It is explained how to construct space vectors from the physical quantities and the difference between space vectors and the vectorial representation of complex quantities is highlighted. Afterwards the common reference frames when dealing with ac-machines are presented.<br>Three types of drives -the dc-machine, the permanent magnet synchronous machine (PMSM) and the induction machine (IM)- are discussed in the second part to show how to control their torque. Starting with the most easiest type of drive, from the point of view of control theory, the block diagram of the drive is derived. Then different options to control the torque are presented: Linear controller, hardware hysteresis controller, field-oriented control and direct torque control, whereas the field-oriented control of PMSM and IM is in the main focus. The models/observers needed for field orientation of the IM are developed throughout this course. This second part is the most substantial.<br>The third part finally deals with the speed control of drives. As the different types of drives are discussed to the point of torque control in the second part, they on principle can be considered equivalent from the speed control point of view. |
| Specific requirements for participation | basics in control theory and<br>basics of Energy Engineering |
| Course dates | 15/04/2024-19/07/2024<br>(planned for Tuesday 09:50 to 11:30 am & Friday, 08:00 to 09:40 am) |
| Synchronous / Asynchronous | synchronous |
| Exam format | written or oral |
| N. of available positions for U! students | 16 |
| **Course supervisor (name)**<br>Prof. Dr.-Ing. Gerd Griepentrog | **Contact (Mail)**<br>gerd.griepentrog@lea.tu-darmstadt.de |
| Additional information/Weblink | Control of Drives – Institute for power electronics and control of drives – TU Darmstadt (tu-darmstadt.de) |

| **University**<br>TU Darmstadt | **Country**<br>Germany |
|---|---|
| **Course title**<br>Energy from Nuclear Fusion | |
| Faculty | Physics - Laser and Plasma Physics |
| Credits | 5 |
| Level | Master |
| Content | Basics of nuclear energy, nuclear binding energy, nuclear fission, fission reactor concepts, accidents and legacy, proliferation, fusion energy, concepts and basics of nuclear fusion, magnetic fusion concepts, inertial fusion<br>concepts, magneto- inertial fusion, state of the art and future prospects, spin-off and other use for fusion power. |
| Specific requirements for participation | Basic knowledge in energy production.<br>Basic knowledge in physics at BSc. Level. |
| Course dates | 15/04/2024-19/07/2024<br>(planned for Monday 09:50 to 11:30 am and Thursday, 09:50 to 10:40 am) |
| Synchronous / Asynchronous | synchronous |
| Exam format | oral (passed/not pass grading) |
| N. of available positions for U! students | 8 |
| **Course supervisor (name)**<br>Prof. Dr. rer. nat. Markus Roth | **Contact (Mail)**<br>markus.roth@physik.tu-darmstadt.de |
| Additional information/Weblink | RG M Roth – Institute for Nuclear Physics – TU Darmstadt (tu-darmstadt.de) |