University *of Ljubljana*
Faculty *of Mechanical Engineering*

# Energy Conversion Systems 5 ECTS

**Lecturer:** **M. Sekavčnik**

Lectures: 30h | Tutorials: 12h | Labs: 18h | Project: 0h | | Lang. :

## Objectives

- Use and integration of basic and applied energy knowledge to model energy and mass flows in complex energy systems.
- Implementation of methods for thermodynamic optimization of thermodynamic cycles and analysis of system irreversibilities within the energy conversion chain.
- Use and development of new knowledge to design appropriate/sustainable technological solutions for modern power and heat supply.
- Evaluation of broader aspects of energy supply transformation.

## Programme

Within the framework of the Energy Conversion Systems subject, the role of energy-supply sectors as a socio-economic subsystem in modern society, as well as the physical, economic, and environmental laws that have a decisive influence on the structure of the energy supply paradigm and thus infrastructure is presented. In the following, students acquire theoretical knowledge for modelling and thermodynamic analysis of right thermodynamic cycles, such as: Rankine cycle, Joule-Brighton cycle, combined gas-steam turbine cycle, combined heat and power processes. On the basis of theoretical knowledge of thermodynamic principles, students learn about the particular system components and operation of real systems for the conversion of heat into electricity for each of the technologies from the point of view of energy efficiency, reducing the impact on the environment and the economy of production such as: thermal power plants on fossil fuel, nuclear power plants, gas turbine power plants, combined gas -steam turbine power plants, organic Rankine cycles for utilization of low-temperature heat. In the following, students get to know the theoretical laws for modelling of energy systems for the use of renewable energy sources, such as hydropower plants, wind and solar power plants. This also includes consideration of energy storage systems such as pumped-storage hydropower plants, batteries, flywheels, and fuel synthesis. Students learn about hydrogen technologies, which include technologies for the production, storage and transport of hydrogen as an energy carrier or as a feedstock for synthetic hydrocarbons. Based on the acquired theoretical knowledge and analysis, a critical assessment of the feasibility of energy supply solutions in the future, which are dictated by energy and climate policies, is given.

## Prerequisites

Meeting the enrolment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.

## Learning outcomes

After attending this course, the student will:

- Have thorough theoretical, methodological and analytical knowledge with elements of a research work that form a basis for very demanding professional work
- Master very demanding and complex work processes and methodological tools in specialised professional fields.
- Be able of planning and managing of the working process based on creative solving of problems that are linked to the teaching and training content.
- Be able of unique innovations and critical reflections.

## Assessment

- Theoretical contents (lectures) – 50 %
- Coursework – 10 %
- Laboratory exercises – 20 %

## Literature


- Strauß K.: Kraftwerkstechnik, zur Nutzung fossiler, nuklearer und regenerativer Energiequellen, Springer, 2009
- Kopanos G.M., Liu P., Georgiadis M.C.: Advances in Energy Systems Engineering, Springer, 2017