

**FS****UNIVERSITY OF LJUBLJANA**
Faculty of Mechanical Engineering

Sustainable Sources of Electric Energy (6010-M)

5 ECTS**Lecturer:** **M. Hočevor, M. Petkovšek**

Lectures: 30h

Tutorials: 6h

Labs: 24h

Project: 0h

Lang. :



Objectives

- To learn the principle of operation of hydro and wind power plants and solar cells.
- To learn the basic building blocks of hydropower and wind power plants.
- Understand energy conversions in machines and devices for the use of sustainable energy sources.
- Understand the interaction of machines and devices for utilizing sustainable energy sources with the grid.
- Know the ways and importance of energy storage.

Programme

- Introduction, the importance of water and wind turbines and solar cells in the electricity system today and in the future.
- Water turbines: components of the turbine flow tract and importance for operation (Pelton, Francis, Kaplan and tube turbines), properties, design and operation.
- Euler equation, velocity triangles, characteristic, efficiency and hill diagrams.
- Manufacture of water turbines (Pelton, Francis, Kaplan): blades, hub, and ring.
- Elements of a water power plant: dam, surge tank, tunnel, duct, penstock, pre-turbine valve, bypass, outlet, etc., auxiliary components of water turbine: bearings, seal, creep detector, brakes, turbine regulator, etc., spillway building blocks: barriers, locks, teeth, fish lanes.
- Wind turbines: conservation of mass flow and energy, Betz criterion, power factor, thrust coefficients, drag and lift. Wind turbine efficiency, maximum power, materials for wind turbine blades, power control, stall, velocity triangles.
- Solar cells: principle of operation, semiconductors, materials, technologies, efficiency.
- Biomass and geothermal power plants overview, operation, efficiency
- Importance of a power plant's rapid response to the provision of network system services: importance for quick start-up and primary control. Energy storage with pumped-storage power plants, batteries, etc.

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:

- Be capable of designing sustainable electric energy systems,
- Be able to contemplate the interaction of systems for the supply of electricity from sustainable sources and the electricity grid
- Have the ability to diagnose the specifics and failures of sustainable electric energy systems
- Be able to make decisions regarding the operation of sustainable electricity generation devices and systems
- Have ability to think critically and evaluate the environmental impact of sustainable power generation plants and systems

Assessment

- Participation in lab work – 80 % participation minimum
- Lab report – all reports must be submitted
- Laboratory exams – 50 %
- Theoretical exam – 50 %

▪ Kreith F., Goswami, D. Yogi, Handbook of Energy Efficiency and Renewable Energy, CRC Press, 2007.

▪ Raabe, J.: Hydro power: the design, use and function of hydromechanical, hydraulic and electrical equipment.- Düsseldorf: VDI, [COBISS.SI-ID 378907], 1985.

Literature