

Name of the course	Sustainable solar-hydrogen systems
Number of instruction hours	20
Outline of course/module content	Structure of energy sector. RENEWABLE ENERGY SOURCES: Application and storage problems, potential of energy production, sustainable indicators. SOLAR PHOTOVOLTAIC SYSTEMS: PV cells technology, current-voltage characteristics, efficiency, pay-back periods for embodied energy and potential for CO ₂ production. ALTERNATIVE FUELS: status and trends in production and use of alternative fuels: fossil fuels, synthetic hydrocarbon fuels – GTL / CTL / BTL; renewable fuels – biofuels; hydrogen as an energy carrier and environmentally friendly fuel; hydrogen economy. PRESENT AND DEVELOPING HYDROGEN PRODUCTION PROCESSES: Thermal: reforming (steam, autothermal, membrane, MeO cycle), partial oxidation, gasification (IGCC), thermochemical water splitting. Electrolytic, photolytic and bioconversion processes. Electrode kinetics and thermodynamics of water electrolysis. Electrodes of improved electrocatalytic activity and stability. HYDROGEN STORAGE: physical, chemical; hydrides. HYDROGEN FUEL CELLS: mechanism of reactions, kinetics and thermodynamics, types of cells. Need for technical improvement and R&D programmes for fuel cells and hydrogen economy. SOLAR-HYDROGEN SYSTEMS: System configuration; Hydrogen balance equation; System management (economic estimate, determining the nominal electric power of the PV generator and hydrogen storage); OPTIMIZATION MODEL: Defining the objectives (MIN-MAX), Model formulation; Constraints in the optimization model; Recursive formulas of the optimization process; Verification of the optimization model.
Description of instruction methods	Lectures and laboratory/computer exercises.
Description of course/module requirements	Written report and oral exam.