UNIVERSITY OF LJUBLJANA
Faculty of Mechanical Engineering

Solar Utility Technologies (6016-M) 5 ECTS

Lecturer: **C. Arkar, P. Poredoš**

Lectures: 30h | Tutorials: 10h | Labs: 20h | Project: 0h | Lang. :

Objectives

The objectives of this course are to provide students with a comprehensive understanding of solar energy as a key renewable energy source, its physical principles, technological solutions, and role in the transition towards a sustainable energy system. The course introduces the fundamentals of solar radiation, radiative heat transfer, and the conversion of solar energy into heat, cooling, and electricity, with a particular focus on building-related applications. Special attention is given to the assessment, design, and performance evaluation of solar thermal and photovoltaic systems, as well as to their environmental impacts.
This course will thus browse:

- the potential, prospects, and long-term role of renewable energy sources, with particular focus on solar energy;
- the fundamentals of radiative heat transfer and the selective optical properties of surfaces relevant to solar applications;
- the assessment of solar radiation and radiative heat exchange processes, highlighting their influence on the performance and efficiency of solar technologies;
- the design and modelling of solar thermal and photovoltaic technologies, addressing building applications, innovative solutions, and emerging technology trends.

Programme

1. Renewable energy sources, their potential and prospects until 2050
2. Heat transfer by radiation and optical properties of surfaces for solar and long-wave radiation
3. Extraterrestrial and terrestrial solar radiation and irradiation, and evaluation of shading
4. Solar thermal systems – from passive and active systems in buildings, including solar cooling, to high-temperature systems
5. Photovoltaic technologies, systems in buildings, and modelling

Prerequisites

In order to successfully achieve this course, the students must have:

- Good knowledge of thermodynamics and heat transfer

Learning outcomes

After attending this course, the student will:

- demonstrate sound theoretical, methodological, and analytical knowledge in the field of radiative heat transfer and the conversion of solar radiation into heat, cooling, and electricity
- dimension, design, and control the operation of solar energy systems, and solve related problems using creative thinking
- apply critical thinking when evaluating solar technologies and systems, taking into account their environmental impacts

Assessment

Final grade: 50% two theoretical colloquia (lectures) during the semester; and 50% based on Moodle quizzes completed during laboratory work and tutorials.

Literature

Duffie, J. A., Beckman, W. A. Solar engineering of thermal processes. 2nd Edition. John Wiley & Sons, Inc., New York, 1991

Tiwari, G. N., Tiwari, A., Shyam. Handbook of Solar Energy: Theory, Analysis and Applications. Springer Singapore, 2016

Medved, S., Domjan, S., Arkar, C. Sustainable technologies for nearly zero energy buildings: design and evaluation methods. Cham: Springer, 2019