Level: bachelor

Course title: Atmospheric Radiation

Status: elective

ECTS: 6

Requirements: none

Learning objectives

Providing the basic knowledge about the electromagnetic radiation in the atmosphere, its origin, transfer, absorption and scattering and their consequences to short term and long term atmospheric processes.

Learning outcomes

After taking the course, the student should have developed:
General capabilities: basic knowledge of this field, following the literature, analysis of various solutions and the choice of most adequate solution, application in practice and other subjects.
Subject-specific capabilities: knowledge of radiometric quantities and laws of their transfer; knowledge of the laws radiation – substance interaction, in particular various types of spectra; understanding of solar energy transfer to the Earth; understanding of the influence of radiative processes to climate.

Syllabus

Theoretical instruction

Basic ideas about radiation. Photometric and radiometric quantities and units. The notions of absorption and scattering (Rayleigh and Mie). Thermal radiation. Kirchhoff's law. Black body radiation. Rayleigh-Jeans and Planck theory. Radiation transfer. Transfer equation. Bouguer-Berr-Lambert law. Schwarzschild equation. Transfer equation for stratified atmosphere. Foundations of atomic physics. Atomic spectra, structure and models of atom. Foundations of quantum mechanics and probabilistic interpretation of the wave function. Schroedinger equation: linear harmonic oscillator, hydrogen atom. Quantum mechanics of many-electron atoms and molecules. Emission and absorption of light. Spectra, width and shape of spectral lines. Lasers. Molecular spectra – general theory, rotational, vibrational and electron spectra. Sun as an energy source. Earth's orbit around the Sun - Earth insolation theory of M. Milanković. Solar spectrum and solar constant. Insolation distribution. Calculation of heating. Absorption of Solar radiation in atmosphere. Absorption in ultraviolet range of spectrum. Photochemical processes and forming of ozone layer. Absorption in visible and close infrared range of spectrum. Calculation of heating due to Solar radiation absorption. Infrared radiation transfer in the atmosphere. Spectrum of thermal IR radiation, its transfer through atmosphere and greenhouse effect. IR absorption spectra of atmospheric gasses. IR radiation transfer in stratified atmospheres. The concept and application of the transmission function. Theoretical band models. Influence of CO2 to climate.

Practical instruction

Problem solving, seminars.

Weekly teaching load				Other:
Lectures: 3	Exercises: 1	Other forms of teaching: 1	Student research:	