MODULE INFORMATION SHEET

Name of Module Unit	**Environmental Physics**
Name in polish language	Fizyka środowiska
Module type	compulsory / ~~elective~~
Form of studying	full-time day courses
Level of study	graduate course (M.Sc. level)
Type of study (for extra-mural courses)	-
Programme	Environmental Engineering
Speciality	Environment Protection Engineering
Responsible department	Chair of Environmental Protection and Management
Responsible person	Prof. Lech Łobocki

Semester	Lectures(E)	Tutorials	Laboratory	Computer Exercises	Projects	ECTS
3	30E			15		4

Learning outcomes (knowledge, skills, competences)

Basic knowledge of selected topics in physics as applied to environmental problems. knowledge of physical processes in the atmosphere and hydrosphere with application to particular environmental problems. Computer assignments using Python give the students an opportunity to practice the application of theoretical knowledge to computer-based problem solving. Competences: confirmed ability of applying knowledge in particular problems and applications

Prerequisites

Calculus, Information Technology, Environmental Fluid Mechanics, Scientific Programming and Data Analysis

Rules for integrated grade setting

60 % exam, 40% computer exercises

Recommended readings

Iribarne J.V, Cho H.R., 1980, Atmospheric Physics, D. Reidel
Iribarne J.V, Godson W.L., 1981: Atmospheric Thermodynamics. D. Reidel
Stull R.B., 1988: An Introduction to Boundary-Layer Meteorology, Kluwer
Brutsaert, W., 1991: Evaporation into the Atmosphere, Springer
Sorbjan, Z. Structure of the Atmospheric Boundary Layer
Eagleson P.S., 1970: Dynamic Hydrology. Mc-Graw Hill.
Vallis G., 2019: Essentials o Atmospheric and Oceanic Fluid Dynamics, Cambridge UP

Contents of lectures (syllabus)

	Topics	Time (hrs.)	Scope (S / Ex)
1	Energy transfer in environment, radiation laws and radiative transfer.	2	S
2	Radiative equilibrium, greenhouse effect.	1	S
3	Atmospheric thermodynamics, extension of hydrodynamics to thermohydrodynamics.	4	S
4	Static equilibrium, potential temperature.	2	S
5	Phase changes of water and their energetical consequences. Humidity variables.	4	S
6	Hydrological cycle, land surface energy budget and its parametrizations.	4	S
7	Turbulence in environmental flows. Shallow motion (Boussinesq) approximation. Statistical description, Reynolds stress, Reynolds equations. Turbulent fluxes, turbulence kinetic energy and its budget.	5	S
8	Similarity theory and dimensional analysis.	1	S
9	Spatial turbulence scales, dissipation and Kolmogorov hypotheses. Parametrization of turbulent transfer, Boussinesq hypothesis, first-order closure models. Monin-Obukhov similarity theory.	4	S
10	Turbulence potential energy. Reynolds equation closure system, second-order closure. Models of surface energy budget and planetary boundary-layer dynamics.	3	S
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Lecturers

Dr hab. inż. Lech Łobocki – prof. PW

Assessment method

Written exam

Contents of computer exercises

	Topics	Time (hrs.)	Scope (S / Ex)
1	Calculation of radiative fluxes incident on arbitrarily oriented surfaces.	3	S
2	Aerological thermodynamic diagrams	1	S
3	Calculation of humidity quantities	1	S
4	Surface energy budget parametrization	3	S
5	Calculation of surface-layer parameters	2	S
6	Simulation of the diurnal evolution of atmospheric boundary layer	3	S
	Total	**15**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Persons responsible for computer exercises

Dr hab. inż. Lech Łobocki – prof. PW

Assessment method for computer exercises

Grading assignment reports, active participation in classes