COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10YK302**	**SEMESTER**	**7**
COURSE TITLE	**Atmospheric Boundary Layer Physics**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	4	6

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized knowledge
PREREQUISITE COURSES:	No (recommended Fluid Dynamics)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language if there is interest from Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS349

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The Atmospheric Boundary Layer (ABL) course provides the student with advanced knowledge to understand the natural processes that contribute to the structure and development of the atmospheric boundary layer. The student understands how the basic conservation and transport laws (from fluid dynamics) are applied to describe and understand the atmospheric boundary layer and many of the phenomena that occur in it.

The basic laws equations are mainly given in algebraic form and the emphasis is on the physical interpretation of each term. The student understands the spatial patterns of the various physical parameters within it (such as wind, temperature, etc.) and learns how to solve problems - applications in the atmospheric boundary layer that comes in direct interaction with the surface.

Within the content of this course, it is difficult to understand and handle both mathematical equations and data. This is mainly due to the turbulent behavior of the physical properties of the atmosphere.

With the completion of the course the student is able to

- recognize the behavior of the ABL from a thermodynamic point of view and to select and apply the relevant laws according to the atmospheric conditions
- understand the spatial and temporal behavior of the basic physical parameters of the ABL.
- define the basic layers of ABL and describe and interpret their physical characteristics
- be familiar with the principles and criteria governing the stability / instability of the atmosphere, as well as their effect on the development of the ABL.
- analyze experimental measurements and extract quantitative results for atmospheric parameters and processes (eg, momentum and heat transfer) and draw conclusions about the effect of various factors (such as topography, roughness, synoptic condition, etc.) in the evolution of the atmospheric parameters.

- explain the basic concepts, principles and laws describing the physical processes of the ABL.
- identify and examine the basic terms of the fluid dynamics be valid in the different layers of the ABL, under different atmospheric conditions as well as in different areas (eg complex topography, different latitudes)
- calculate various physical parameters with the appropriate equations.
- analyze experimental measurements and extract quantitative results for physical parameters (eg momentum and heat transfer); and
- draw conclusions on the influence of various factors (such as topography, roughness, synoptic condition, etc.) in the evolution of atmospheric parameters

- compose concepts and laws that lead to the solution of complex processes such as those existing in the turbulent atmospheric boundary layer.
- combine equations in solving complex problems in atmospheric physics.
- compare and evaluate the results of the problems.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

The course aims at the following general competences

Decision-making
Working independently
Respect for the natural environment
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Introduction - The atmospheric boundary layer over flat uniform terrain
- ABL structure and depth. ABL formation under different atmospheric stability
- Conservation and momentum, heat and humidity transfer for laminar and turbulent ABL.
- Turbulent kinetic energy - Stability criteria
- Turbulent flows - Mean and turbulent parts.
- Turbulence Closure theories - Similarity theory - Wind profile evolution
- Flow over complex topography (changing terrain, canopies, hills)
- Local winds (e.g. Thermally driven, up and down-slope winds)
- Marine Atmospheric Boundary Layer

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Yes

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures/ Exercises</td><td>52</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>95</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Notes by M Tombrou mainly based on Chapter 18 of Meteorology for Scientists and Engineers, by Roland Stull
- Notes from C. Chelmis and G. Papaioannou
- Meteorology for Scientists and Engineers, 3rd Edition, 2015 by Roland Stull (http://www.eos.ubc.ca/books/Practical_Meteorology/ ISBN-13: 978-0-88865-178-5)
- Atmospheric Boundary Layer Flows Their Structure and Measurement J. C. KAIMAL J. J. FINNICAN, 1994, New York Oxford, OXFORD UNIVERSITY PRESS