COURSE OUTLINE

(1) GENERAL

SCHOOL	FACULTY OF SCIENCES		
ACADEMIC UNIT	PHYSICS DEPARTMENT		
LEVEL OF STUDIES	POSTGRADUATED		
COURSE CODE	**M221**	**SEMESTER**	**2**
COURSE TITLE	ATMOSPHERIC 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**
	4	9
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	general background, special background, specialised general knowledge, skills development
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

(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 course is offered to Master students of Atmospheric Sciences having either limited or zero knowledge about the Physics of the Earth's Atmosphere. It aims to provide students with an integrated training on topics related with the natural processes and various phenomena taking place into the Earth's atmosphere. Given the broad range of atmospheric phenomena, the course intends to cover as more as fields of the contemporary Atmospheric Physics. Upon successful completion of the course, the students are expected to:

- know what are the subject, the methodology and the different applications of the Atmospheric Physics.
- learn what are the various atmospheric parameters, their observation and measurement methods and their units and conversions.
- Know what are the basic patterns of the atmospheric structure and composition. More specifically, to know features of the horizontal and especially the vertical distribution of the state variables of the atmospheric air, namely of its pressure, density and temperature.

- learn what are the various layers of either the lower or middle and upper atmosphere, and to interpret their different properties and characteristics, particularly in terms of state variables .
- have a detailed knowledge of the composition of modern/current atmosphere of the Earth, and the distribution of its various stable and variable components, with emphasis to the atmospheric gases.
- learn the theory, derive and apply key equations, like the equation of state or the hydrostatic equation, in case of the atmospheric air, as well as their various applications in order to explain the behavior of dry and moist atmospheric air .
- know the principles and significance of the presence of water into the Earth's atmosphere and of the water phase changes.
- have a good knowledge of the thermodynamics of the atmospheric air and of the applications of thermodynamic laws in the case of the atmosphere.
- have a deep knowledge and understanding of physical, and to lesser extent of chemical, processes regulating phenomena like the ozone hole and relevant issues like the ultraviolet surface solar radiation.
- know the principles and different criteria of atmospheric stability and relevant applications and consequences.
- learn the physical meaning, the construction and explanation of the main types of thermodynamic atmospheric diagrams.
- have a basic knowledge about cloud microphysics, and specialized knowledge about atmospheric aerosols and their physical properties, warm and cold phase clouds and the cloud and precipitation formation processes.

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…*
	…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Respect for the natural environment
Adapting to new situations
Decision-making
Working independently
Team work
Criticism and self-criticism
Production of free, creative and inductive thinking

(3) SYLLABUS

The subject of Atmospheric Physics. Main atmospheric parameters. Structure and composition of the atmosphere. Horizontal and vertical variation of atmospheric pressure and density. Composition of atmospheric air. Sources and sinks of the various stable and variable atmospheric air gases. Patterns of geographical (horizontal and vertical) distribution of the main atmospheric components and their temporal variability. Temperature structure of the atmosphere and horizontal and vertical temperature variation. Atmospheric boundary layer, free troposphere and factors that determine their temperature and humidity profiles. Stratosphere and physical and chemical processes that regulate the creation and evolution of the ozone hole. Ultraviolet (UV) solar radiation and its relation with the ozone hole, monitoring of ozone hole and UV radiation. The equations of state for the dry and moist atmospheric air and their applications. The hydrostatic equation of the atmospheric air and its applications for the computation of pressure and height in the terrestrial atmosphere. Geopotential, geopotential height and scale height. The water in the atmosphere and the water phase changes, latent heats, Clausius-Clapeyron equation. The first thermodynamic law for the atmospheric air and its applications in various atmospheric processes. Dry and moist adiabatic temperature lapse rates, pseudo adiabatic lapse rate. Adiabatic processes in the atmosphere. Potential temperature. Thermodynamic diagrams and their application for studying various atmospheric processes. Atmospheric static stability/instability for the unsaturated and saturated atmospheric air. Stability criteria for the atmospheric air. Specific types of atmospheric instability. Aerosols and their sources, Aerosol types and physical properties, The role of aerosols for cloud formation and development, Cloud microphysics, Theories of cloud formation and development, Theories of precipitation formation, Warm and cold clouds, Weather modification.

Students assist to undergraduate laboratory courses, supervising and advising undergraduate students during the experiments and the analysis of their measurements, while they take part in the correction/evaluation of undergraduate students' laboratory reports.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
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*	see table below

Activity	***Semester workload***
Lectures	52
Tutorials	22
Study of bibliography	112
Laboratory practice	36
Examinations	3
Course total	***225***

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*	Written examinations at the end of semester, in greek (or in English in case of foreign students), which include open-ended questions as well as problem solving. Additionally, two or three projects requiring data acquisition/processing/analysis as well as reporting

examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	computed results are assigned to the students. The marks of these projects contribute to the final grade provided that the final examination grade is promotable. Evaluation of MSc students is also based on their performance during their assisting role in the laboratory courses.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:

- Atmospheric Physics (in greek), B. D. Katsoulis and N. Hatzianastassiou, Ioannina University Press, Ioannina, Greece (2006).
- General Meteorology (in greek), H. S. Sahsamanoglou and T. Makrogiannis, Zitis Publications, Thessaloniki, Greece (1998).
- Atmospheric Science, J. M. Wallace and P. V. Hobbs, Academic Press, San Diego, California, USA (2006).
- An introduction to atmospheric thermodynamics, A. A. Tsonis, Cambridge University Press, Cambridge, UK (2002).
- Electronic notes, N. Hatzianastassiou (yearly updated).