COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10YK102**	**SEMESTER**	**7**
COURSE TITLE	**Astrophysical Fluids**		

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*	Specialised Knowledge
PREREQUISITE COURSES:	No (recommended Mechanics I, Fluid Dynamics)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS344/

(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*
This course aims to introduce the student to basic concepts of Fluid Dynamics and Plasma Physics and how they are used in Astrophysics to model phenomena, taking into account, when needed, self-gravity and magnetic field. It also gives him the opportunity to go beyond a qualitative presentation in the quantitative use of the basic theoretical tools for further modeling of the relevant physical phenomena. At the end of the course, each student will be able to: 1. Identify the basic spatial and temporal scales that characterize a plasma. 2. Combine knowledge of basic courses (mainly Mechanics I, Fluid Dynamics) to describe the dynamics of plasma as magnetized fluid (magnetohydrodynamics). 3. Understand how the basic conservation laws can be derived through kinetic theory and how they are combined with Maxwell's laws. 4. Apply the above to a plethora of astrophysical problems, analyze, and qualitatively/quantitatively describe the results.
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* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Decision-making Working independently Analytical and synthetic thinking Critical thinking Time management Creativity Meeting Deadlines and Keeping Schedules Problem solving

(3) SYLLABUS

- Introduction. Equations and conservation laws for compressible fluids.
- Lane-Emden equation. Static atmosphere. De-Laval nozzle. Parker wind.
- Bondi accretion. Accretion disks.
- Plasma properties and parameters.
- Equations of magnetohydrodynamics. Magnetic pressure and tension.
- Dynamo equation: advection and diffusion of the magnetic field.
- Magnetohydrodynamic waves. Shock waves.
- Fluid interaction. Blast waves.

(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)
eclass platform where sets of problems are posted and solutions from students are uploaded</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>Lectures</td><td>52</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>60</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Writing reports/ essays</td><td>35</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
Homeworks, Problem solving</td></tr>
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(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography (given through the EYDOXUS platform):*
  - Βιβλίο [68404097]: Αστροφυσική Πλάσματος, Τσίγκανος Κανάρης

- *Other:*
  - Principles of Astrophysical Fluid Dynamics, C. Clarke, B. Carswell
  - Modern Classical Physics, K. S. Thorne, R. D. Blandford
  - Fundamentals of Plasma Physics, Paul Bellan
  - The Physics of Plasmas, Richard Fitzpatrick
  - The Physics of Plasmas, T. J. M. Boyd, J. J. Sanderson
  - Αστροφυσική Υψηλών Ενεργειών, Α. Μαστιχιάδης, Ν. Βλαχάκης
  - Δυναμική των Ρευστών, Ν. Βλαχάκης