COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10EK103**	**SEMESTER**	**8**
COURSE TITLE	**GALAXIES**		

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
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS347/

(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 provides students with the necessary knowledge to understand the formation, evolution, structure, and morphology of galaxies. It provides knowledge regarding:

• Interstellar matter and its properties, such as temperature, density, and mass of (molecular or atomic) gas, dust.
• Collapse of gas towards star formation and the role of stellar mass distribution in the evolution of galaxies. Collapse of gas towards large scale structure formation. Collapse of gas towards galaxy formation.
• Morphology and kinematics of galaxies and their relations linked to stellar orbits. Mass measurements of galaxies (e.g., from stellar population modelling, from rotation curve modelling). Evolution of galaxies over time, including changes in their morphology, structure, and chemical composition.
• Formation, growth, and mass measurement of black holes. Differences in the formation of primordial and present-day black holes. Extraction of the mass locked in black holes at various epochs of the Universe. Accretion of matter onto black holes, subsequent radiation, and detection of black holes. Identification and characteristics of active galactic nuclei, lifetime in active phase.
• Dark matter in galaxies. Detection and spatial distribution. Matching galaxies to dark matter halos in cosmological simulations.
• Galaxies and cosmology: recession due to the expansion of the Universe, distances of galaxies as a function of time or redshift in cosmological models. Changes in fundamental galaxy properties such as flux or length as a function of time.

Upon attendance and successful completion of the course, the students will have an overview of the natural processes that govern galaxies, will be able to understand and evaluate articles about galaxies, and will acquire the fundamental knowledge for conducting scientific research related to galaxies, through either observations or models and theory.

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

Production of free, creative and inductive thinking
Analytical and synthetic thinking

Critical thinking
Time management
Planning
New Technology skills
Information management
Meeting Deadlines and Keeping Schedules
Creativity
Communication skills
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

• Interstellar matter and its phases. Gas collapse and star formation. Initial mass function of stars and its impact on galaxies.
• Gas cooling and heating functions. Gas mass determination: optically thin/thick limit, 2-level system approximation.
• Galaxy formation. Gas collapse and galaxy formation. Measuring galaxy masses (e.g. from rotation curves, stellar population synthesis models).
• Morphology of galaxies. Detailed models of light and mass distribution.
• Galaxy evolution. Detection of galaxies. Changes in galaxy morphology (due to gas inflow/consumption over time, galactic collisions). Mass function and its evolution.
• Formation of first black holes. Luminosity function and its evolution over time, determination of mass locked into black holes per era of the Universe.
• Active galactic nuclei. Unification model. Diagnostics of active nuclei based on gas properties. Lifetime in an active phase.
• Dark matter and galaxies: detection, profile, and proposed particle properties.
• Large scale structures. Early Universe. Formation and detection of large scale structures.
• Observational cosmology. Cosmological parameters. Distances. Evolution of observable properties with time.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	
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.*	Final written exams Written exercises

Activity	Semester workload
Lectures	52
Individual Study/ Study and Analysis of bibliography / Preparation	95
Exams	3
Course Total	150

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography*

- The Physical Universe: An introduction to Astronomy, Frank Shu, Publisher, University Science Books, 1982
- An introduction to active galactic nuclei, Bradley M. Peterson, Publisher: Cambridge, New York Cambridge University Press, 1997
- Introduction to Cosmology, Barbara Ryden, Cambridge, UK: Cambridge University Press, 2016
- Theory of Star Formation, Chris McKee & Eve Ostriker, Annual Review of Astronomy & Astrophysics, vol. 45, Issue 1, pp.565-687