

Name: Astrophysics and Cosmology - 34050**Type:** introductory**Semester:** 1st**ECTS:** 7.5**Periodicity:** annual**Departments involved:** Department of Physics and Nuclear Engineering (UPC)
Department of Applied Physics (UPC)**Coordinator:** Jordi José Pont**Professors:** Enrique Garcia-Berro Montilla, Pilar Gil Pons, Jordi José Pont**Language:** Catalan / Spanish / English**Prerequisite:****Aims:**

The aim of this subject is to provide a wealth of knowledge and basic tools for the analysis of astronomical and cosmological problems. Due to the strong interdisciplinary profile of this subject we will devote many efforts to introduce the basic physical concepts rigorously.

The course is addressed both to students of scientific and technological matters that would like to initiate solidly in the concepts and techniques of modern astrophysics.

Syllabus:**I. Basic concepts**

- I.1 The celestial sphere. Astronomical coordinates. Time.
- I.2 Astronomical instrumentation. Ground-based instruments: Telescopes, Radiotelescopie and neutrino detectors. Space-borne observatories.
- I.3 Stellar parameters: luminosity, temperature, magnitude; The size of the stars.
- I.4 Distance indicators. Distance measurements in astronomy. The HR diagram. Stellar populations.

II. Models of stellar structure

- II.1 Equations of stellar structure: hydrostatic equilibrium, momentum and energy transport and conservation. Rotation.
- II.2 Constitutive equations: EOS, ionization, opacity, nuclear reactions.
- II.3 Simple stellar models: polytropes, spherically-symmetric numerical models.

III. Stellar evolution

- III.1 Stellar birthplaces. The Main Sequence.
- III.2 Advanced states of stellar evolution. AGB stars and planetary nebulae.
- III.3 Stellar explosions, stellar remnants and compact objects.
- III.4 Evolution in binary systems.

IV. The structure of the Galaxy

- IV.1 Main characteristics of the Milky Way. Components.
- IV.2 The interstellar medium.
- IV.3 Galactic kinematics.
- IV.4 Chemical evolution of the Galaxy and stellar evolution
- IV.5 The age of the Galaxy
- IV.6 The dark matter problem. Detection techniques.

V. The large-scale structure of the Universe

- V.1 Galaxy classification
- V.2 Active Galactic Nuclei. Quasars.
- V.3 Interacting galaxies.
- V.4 The intergalactic medium.
- V.5 Cluster and superclusters.

VI. Cosmology.

- VI.1 The cosmological principle.
- VI.2 Physical bases of modern cosmology: general relativity and Big-Bang. Inflation. Matter vs. anti-matter. Expansion, background radiation and primordial nucleosynthesis.
- VI.3 Dark matter and dark energy. Acceleration of the rate of expansion.
- VI.4 The final fate of the Universe.

Method & Evaluation:

The course will be evaluated by means of a written test as well as by a handful of activities that will be performed throughout the whole course. The test will have a weight of 60% on the overall mark, while 40% will be given to additional activities, including homework assignments (solution of astrophysical and cosmological problems) and public defence of a research paper previously assigned by one of the professors.

This has the purpose to consolidate the wealth of knowledge learned through the course and also to introduce the students in the framework of scientific research and specifically in the art of science discussion and communication.

Bibliography:

- Freedman, W.H; Roger A.; Kauffmann, William J. Universe. Stars and Galaxies. 6^a Edició, Freeman & Co., New York, 2002.
- Carroll, Bradley W.; Ostlie, Dale A. An Introduction to Modern Astrophysics. 2^a Edició, Addison-Wesley, 2006.
- Shore, Steven N. The Tapestry of Modern Astrophysics. 1^a Edició, Wiley-Interscience, 2002.
- Kippenhahn, R.; Weigert, A. Stellar Structure and Evolution. Astronomy & Astrophysics library, 1^a Edició Springer Verlag 1990.