

Approval date: 22/06/2023

COURSE GUIDE

Astrophysics (26711B2)

Grado (Bachelor's Degree)	Grado en Física	Branch	Sciences				
Module	Astrofísica	Subject	Astrofísica				
Year of study	4 ^o	Semester	2 ^o	ECTS Credits	6	Course type	Elective course

PREREQUISITES AND RECOMMENDATIONS

It is recommended to have taken the following courses:

- Fundamentals in astrophysics
- Atomic and molecular physics
- Electromagnetism
- Optics
- Statistical physics
- Compulsory courses in year 1 and 2

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

Stellar atmospheres, stellar evolution, interstellar medium, properties of galaxies, large scale structure, cosmology.

SKILLS

GENERAL SKILLS

- CG01 - Skills for analysis and synthesis
- CG02 - Organisational and planification skills
- CG03 - Oral and written communication
- CG06 - Problem solving skills
- CG08 - Critical thinking
- CG09 - Autonomous learning skills
- CG13 - Knowledge of a foreign language

SUBJECT-SPECIFIC SKILLS

- CE01 - Knowing and understanding the phenomena of the most important physical



theories

- CE02 - Estimating the order of magnitude in order to interpret various phenomena
- CE03 - Knowing and understanding the mathematical methods necessary to describe physical phenomena
- CE05 - Modelling complex phenomena, translating a physical problem into mathematical language

LEARNING OUTCOMES

- Ability to use the knowledge acquired in different areas in a multidisciplinary field.
- Understanding stellar physics and the evolution of stars.
- Understanding astrophysics of galaxies and the interstellar medium.
- Understanding the different cosmological models.
- Get prepared for astrophysical research.
- Knowledge of the techniques of data acquisition and interpretation of astronomical data.
- Get familiar with astrophysical modelling techniques.

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

- **Topic 1: Radiative transport in stellar atmospheres.** Radiative transport equation. Formal solution. Local thermodynamical equilibrium (LTE). Diffusion approximation. Other solutions. Formation of spectral lines. Non-LTE.
- **Topic 2: Stellar structure, evolution and nucleosynthesis.** Characteristic stellar time-scales. Thermonuclear reactions. Energy transport in stars. Equations of stellar structure. Star formation and evolution. Compact objects and supernovae.
- **Topic 3: Morphology and classification of galaxies,** The Hubble classification of galaxies. Other classifications. The Milky Way. Interstellar medium: HI and HII regions, molecular clouds.
- **Topic 4: Galactic dynamics.** Rotation curve of spiral galaxies and dark matter. Stellar motion in galaxies. Lindblad resonances. Spiral arms and bars. Formation and evolution of galaxies.
- **Topic 5: Large scale structure of the Universe.** The Local Group. Galaxy clusters. Interaction of galaxies. Superclusters. Large scale structure of the universe.
- **Topic 6: Cosmology.** Cosmological models and equations. The Big Bang: inflation and primordial nucleosynthesis. Cosmic microwave background. Acceleration of the expansion of the Universe. Cosmological parameters: Inventory of matter and energy.

PRACTICAL SYLLABUS

Seminars

- Seminars given by professionals about current topics of interest in astrophysics.

Practical sessions and problems: One or several of the practical sessions will be carried out by the students.

Practical session 1. Determination of the distance and age of stellar clusters.

Practical session 2. Calculation of models of the stellar structure of ZAMS.

Practical session 3. Simulations of stellar evolution

Practical session 4. The distance-redshift relation of Hubble-Lemaitre.



Practical session 5. Large scale structure of the universe.
Practical session 6. Galaxy dynamics and dark matter.
Problems and exercises related to the theoretical content of the lectures

RECOMMENDED READING

ESSENTIAL READING

- Binney, J., Merrifield, M.: Galactic Astronomy. Princeton University Press.
- Böhm-Vitense, E.: Introduction to Stellar Astrophysics (Vol. 1-3). Cambridge University Press
- Bowers, R. Deeming, T.: Astrophysics Vol. I & II. Jones and Bartlett Publishers Inc.
- Carroll, B.W., Ostlie, D.A.: "An introduction to Modern Astrophysics". Addison-Wesley Publishing Company
- Clayton, D.D.: Principles of Stellar Evolution and Nucleosynthesis. University Chicago Press.
- Gray, D.F.: The Observation and Analysis of Stellar Photospheres. Cambridge University Press
- Sparke, L.S., Gallagher, J.S.: Galaxies in the Universe. Cambridge University Press
- Schneider, P.: Extragalactic Astronomy and Cosmology, Springer Verlag

COMPLEMENTARY READING

- Combes, F. et al.: Galaxies and Cosmology. Springer.
- Glendening, N. K.: Compact Stars. Springer.
- Kippenhahn, R., & Weigert, A.: Stellar Structure and Evolution. Springer Verlag.
- Longair, M.S., Galaxy Formation. Springer Verlag
- Mihalas, D.: Stellar Atmospheres. W. H. Freeman & Co.

RECOMMENDED LEARNING RESOURCES/TOOLS

NASA/IPAC Extragalactic Database (NED): <http://nedwww.ipac.caltech.edu>
Specialized astrophysical articles: http://adsabs.harvard.edu/abstract_service.html
Sociedad Española de Astronomía: <http://www.sea-astronomia.es/>
Instituto de Astrofísica de Andalucía: <http://www.iaa.es>
Instituto de Astrofísica de Canarias: <http://www.iac.es/divulgacion.php>

TEACHING METHODS

- MD01 - Theoretical classes

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET



The student assessment and final score will take into account the presentation of seminars, the work in problem solving and practical sessions and the final exam, in which the students have to show the skills acquired during the course.

- Exam: 50%
- Practical sessions, problems and participation in class: 50%

EXTRAORDINARY EXAMINATION DIET

The extraordinary assessment test will be the same as the single final assessment test.

SINGLE FINAL ASSESSMENT (evaluación única final)

The students that, according to the rules of the UGR and within the fixed time frame, choose to have a single final assessment test, will make a theoretical (50%) and a practical/problems exam (50%) which will allow a complete assessment of their knowledge.

