UAB
Universitat Autònoma de Barcelona

Introduction to Astrophysics

Code: 100161
ECTS Credits: 5

2024/2025

Degree	Type	Year
2500097 Physics	OT	3

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is recommended to have basic knowledge of Newtonian and relativistic mechanics, thermodynamics, statistical physics, electromagnetism and optics, as well as notions of quantum physics and nuclear physics.

Objectives and Contextualisation

On the one hand, to achieve firm knowledge at the introductory level of astronomical objects (mainly stars, compact objects, galaxies and interstellar dust) and the instrumentation used to observe them; on the other, being able to solve problems (not entirely elementary) based on that knowledge.

Competences

- Act with ethical responsibility and respect for fundamental rights and duties, diversity and democratic values.
- Apply fundamental principles to the qualitative and quantitative study of various specific areas in physics
- Be familiar with the bases of certain advanced topics, including current developments on the parameters of physics that one could subsequently develop more fully
- Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, and before both specialist and general publics

- Develop the capacity for analysis and synthesis that allows the acquisition of knowledge and skills in different fields of physics, and apply to these fields the skills inherent within the degree of physics, contributing innovative and competitive proposals.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Take account of social, economic and environmental impacts when operating within one's own area of knowledge.
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
- Use mathematics to describe the physical world, selecting appropriate tools, building appropriate models, interpreting and comparing results critically with experimentation and observation
- Work independently, have personal initiative and self-organisational skills in achieving results, in planning and in executing a project

Learning Outcomes

1. Analyse the basic conditions for the development of life on planets.
2. Analyse the general formational aspects for white dwarfs, neutron stars and black holes.
3. Apply the phenomenon of gravitational lensing to determining the mass of astronomical objects.
4. Calculate the mass and temperature of stars.
5. Communicate complex information in an effective, clear and concise manner, either orally, in writing or through ICTs, in front of both specialist and general publics.
6. Describe solar atmosphere and the internal structure of the sun.
7. Describe the concepts of opacity and optical depth in stellar atmospheres.
8. Describe the different methods for measuring astronomical distances.
9. Describe the equations of stellar structure.
10. Describe the evolution of stars according to their initial mass in the Hertzsprung-Russell diagram.
11. Describe the origin of chemical elements.
12. Describe the phenomena that lead to the formation of spectral lines.
13. Determine the shape of a galaxy's spiral arms.
14. Explain the explicit or implicit code of practice of one's own area of knowledge.
15. Identify situations in which a change or improvement is needed.
16. Identify the social, economic and environmental implications of academic and professional activities within one's own area of knowledge.
17. Introduce the concept of dark matter and the different candidates for this.
18. Relate the apparent and absolute magnitude of astronomical objects.
19. Use calculus and differential equations in the study of astrophysical phenomena.
20. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
21. Work independently, take initiative itself, be able to organize to achieve results and to plan and execute a project.

Content

1.- Introductory concepts (history of astrophysics, measurements of distance, stellar spectra)

2.- Astronomical instrumentation (telescopes, interferometry, spectrografs, detection of X-rays, gamma-rays, neutrinos and gravitational waves)

3.- Radiation field (specific intensity, radiative flux and pressure, radiative transport)

4.- Stars (birth, star structure, evolution and death, compact objects, binary systems)

5.- Interstellar medium and cosmic rays

6.- Galaxies (types, characteristics, dark matter, evolution, Milky Way)

7.- Clusters of galaxies and large-scale evolution

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problems solving at the classroom	14	0.56	1, 3, 19
Theory lectures	27	1.08	1, 2, 3, 4, 6, 7, 9, 10, 11, 12, 13, 17, 19
Type: Autonomous			
Personal studying	63.5	2.54	6, 7, 8, 9, 10, 12, 18
Preparing and writing a report	12	0.48	

Classes of theory and problems.

Group visit to Parc Astronòmic del Montsec (Àger)

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
2 partial exams, none with a weight bigger than 35%	60%	5	0.2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
Control tests during the course	20%	1	0.04	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 17, 18, 19
Preparing and writing a report	20%	0	0	20
Repesca: recovery of the two partial examinations	60%	2.5	0.1	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 17, 18, 19, 20

Theoretical-practical examinations: with questions and problems about the syllabus taught in class or that the student has worked throughout the course. The examinations will be held on the dates announced for partial examinations in the exam calendar of the faculty. These examinations will have a recovery at the end of the course, for students who have not passed them. The global weight is 60%. It is not considered that the students who have passed the course can improve their mark by presenting themselves in the recovery exam.

Control tests and Continuous assessment during the course. Global weight of All tests: 20%. Due to its nature, this activity does not foresee any recovery exam.

Completion of 1 individual work. The weight of the work is 20%. Due to its nature, this activity does not foresee any recovery exam.

Students that have chosen single assessment (avaluació únca) have to make both partial examinations, the control tests and delivery of the individual work the same day as the second partial examination foreseen by the exam calendar of the faculty.

In order to pass the course it is mandatory to have a mark on all avaluable activities.

Bibliography

- Ostlie& Carroll, "An Introduction to Modern Stellar Astrophysics", Addison Wesley.

- Harwit, "Astrophysical Concepts", Springer (3ª edición).

- Prialnik, "An introduction to the Theory of Stellar Structure and Evolution", Cambridge University Press.

- Shu, "The Physical Universe: An Introduction to Astronomy", University Science Books.

- Sparke & Gallagher, "Galaxies in the Universe", Cambridge University Press.

- Tyler, "Galaxies, Structure and Evolution", Cambridge University Press.

- Padmanabhan "Theoretical Astrophysics" (3 volumenes), Cambridge University Press.

Software

This subject uses the software "Stellarium" (https://stellarium.org). Some exercises and problems can be better resolved with a standard software program, e.g. python

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed