Approval date: 22/06/2023

COURSE GUIDE

Fundamentals of Astrophysics (26711B1)

Grado (Bachelor's Degree)	Grado en Física	Branch	Sciences
Module	Astrofísica	Subject	Fundamentos de Astrofísica

Year of study	2º	Semester	2º	ECTS Credits	6	Course type	Elective course

PREREQUISITES AND RECOMMENDATIONS

It is recommended to have followed the courses:
Física General I and Física General II

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

- Positional Astronomy
- Astronomical instruments
- Solar System
- Stars
- Galaxies
- 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
- CG10 - Creativity

SUBJECT-SPECIFIC SKILLS

- CE01 - Knowing and understanding the phenomena of the most important physical theories
- CE02 - Estimating the order of magnitud in order to interpret various phenomena

- CE03 - Knowing and understanding the mathematical methods necessary to describe physical phenomena
- CE07 - Transmitting knowledge clearly, both in academic as in non-academic contexts
- CE09 - Applying mathematical knowlegde in the general context of Physics

LEARNING OUTCOMES

- Understanding of the general concepts of Astrophysics

- Ability to apply knowledge from other disciplines to solve astrophysical problems.
- Understanding the universality of physical laws obtained on earth.
- Understanding the space-time concept in the universe.
- Knowledge of basic observational techniques in Astrophysics.

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

THEORETICAL CONTENTS:
Block 1: Introduction
- Chapter 0. History of Astronomy and general techniques: History of Astronomy. Distances in Astronomy. Time in Astronomy. Information sources in Astrophysics.
- Chapter 1. Positional Astronomy: Basic concepts (celestial sphere: principal circles and points on the sphere). Astronomical coordinate systems. Perturbations of coordinates: precession and nutation. Parallax.
- Chapter 2. Properties of electromagnetic waves and its measurement: Light. Electromagnetic spectum. Basic photometric concepts. Radiation mechanisms: Atomic and molecular spectral lines, blackbody.
- Chapter 3. Astronomical Instruments: Observing through the atmosphere. Optical Telescopes. Detectors. Radiotelescopes. Other wavelengths.

Block 2: Solar system
- Chapter 4. General properties of the solar system: Components and structure. Kepler Laws. Escape velocity.
- Chapter 5. Planets, satellites, asteroids and comets: What is a planet?. Thermal radiation. Albedo. Magnetic Field. Kuiper belt and Trans Neptunian Objects.
- Chapter 6. Formation of the solar system: Observational fatcs and theories. Exoplanets.

Block 3: Stars
- Chapter 7. Stellar structure: Internal equilibrium conditions. Physical state of gas. Energy production in stars. The sun.
- Chapter 8. Stellar observations: Temperature of stars. Stellar spectra. The Hertzsprung-Russell diagram. Binary stars. Variable stars.
- Chapter 9. Stellar evolution: The birth of stars. Proto-stars. The main sequence. Giant stars. The death of stars. Neutron stars, pulsars and black holes.

Block 4: Galaxies
- Chapter 10. The Milky Way: Interestellar medium. Star clusters. Structure of The Galaxy. Galactic Dynamics. Rotation curve. Spirale arms. Galactic center.
- Chapter 11. Galaxies: General properties: Hubble classification. Distances to galaxies. Active galaxies. Galaxy groups and clusters. Formation and evolution of galaxies.

Block 5: Cosmology

- Chapter 12. Cosmology: Basic notions of Cosmology

PRACTICAL SYLLABUS

Seminars/Tutorials
• Seminars on topics related to contents of the course of particular interest but which cannot be treated in depth during the lectures.
• Discussions/Debates on news related to Astronomy. A critical view to astronomy related news on the mass media.
Laboratory Sessions: These sessions were created as a Innovative Teaching Project of the UGR: "Using a virtual planetarium for teaching Astronomy".
Attendance to the 9 Laboratory practical sessions is mandatory to pass the course.
Practice 1. Positional Astronomy. The celestial sphere.
Practice 2. Mass and distance measurements in the Solar System: 3rd Kepler Law.
Practice 3. Estimate of the mass of a spiral galaxy.
Other extra practices can be introduced to help students acquiring the main competences.
Outside practice sessions:
Practice 1. Astronomy night in Parque de las Ciencias. (including planetarium sesión and Identification/observation of the brightest objects in the sky)

RECOMMENDED READING

ESSENTIAL READING

- Battaner, E.: "Introducción a la Astrofísica". Ciencia y Tecnología, Alianza Editorial.
- Battaner, E., Florido, E.: "100 Problemas de Astrofísica", Alianza Editorial
- Karttunen, H., Kroger, P., Oja, H., Poutanen, M., Donner, K.J.: "Fundamental Astronomy. Springer-Verlag
- Lara, L.: "Introducción a la Física del Cosmos". Editorial Universidad de Granada
- Seeds, M.A.: "Foundations of Astronomy". Wadsworth Publishing Company.
- Shu, F.H.: "The Physical Universe: An Introduction to Astronomy". University Science Books.

COMPLEMENTARY READING

- Carroll, B.W., Ostlie, D.A.: "An introduction to Modern Astrophysics". Addison-Wesley Publising Company
- Ünsold, A., Baschek, B: "The New Cosmos". Springer-Verlag.
- Zeilik, M.: "Astronomy. The Evolving Universe". Cambridge University Press.

RECOMMENDED LEARNING RESOURCES/TOOLS

- Astronomy Picture of the Day: http://antwrp.gsfc.nasa.gov/apod/astropix.html
- Instituto de Astrofísica de Andalucía: http://www.iaa.es/divulgacion/
- Instituto de Astrofísica de Canarias: http://www.iac.es/divulgacion.php
- Sociedad Española de Astronomía: http://www.sea-astronomia.es/

TEACHING METHODS

- MD01 - Theoretical classes

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

The student assessment will take into account the realization of seminars, the work in problem solving and practical sessions and, of course, the tests. The students have to show the skills/competences adquired during the course.
The course could only be passed by an average knowledge of all the content covered by the subject.

- Exam: 65%
- Seminars/problems/tests: 15%
- Practical sessions: 20%
  Attendance to the practical sessions, and a score above 5 in practice is a necessary condition to pass the course.
- The final exam will have two parts. To pass the exam, the score of each part must be above 4 over 10 with an average score equal to or above 5.

EXTRAORDINARY EXAMINATION DIET

The extraordinary assessment session will consist of the same tests/exams as the Single final assessment (see below). This will allow the student to obtain 100% of the total possible score.

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 final assessment test, will make a test covering the theory and problem solving contents, and a practical test in the laboratory. Passing the laboratory test is mandatory to pass the course.The theory and problem solving test will have a weight of 80% of the final score, and the laboratory practical test 20% of the final score. The final theory/problems exam will have two parts. To pass the exam, the score of each part must be above 4 over 10 with an average score equal to or above 5.