

SYLLABUS

FUNDAMENTAL ASTROPHYSICS

MODULE	SUBJECT	YEAR	TERM	CREDITS	TYPE
Astrophysics	Fundamental Astrophysics	2 nd	2 nd	6	Optional
LECTURER(S)			CONTACT INFORMATION		
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			OFFICE HOURS		
			Isabel Pérez: Tue to Thu from 10 to 12h Jorge Jiménez: Mon to Fri from 10 to 11h and Tue from 11 to 12h.		
DEGREE			OTHER SUITABLE DEGREES		
Grado en Física (Physics Degree)			Chemestry Degree Mathematics Degree		
PREREQUISITES and/or RECOMENDATIONS					
Física General I y Física General II (Physics I and Physics II)					
CONTENTS SUMMARY (AS IN MEMORIA DE VERIFICACIÓN DEL GRADO)					
Positional Astronomy, Astronomical Instruments, Solar System, Stars, Galaxies, Cosmology					
GENERAL AND SPECIFIC SKILLS					
<p>GENERAL SKILLS:</p> <ul style="list-style-type: none"> • CT1 Análytical and synthetic thinking. • CT2 Planning and organizing. • CT3 Oral and written communication. • CT6 Problem solving. • CT8 Critical reasoning. • CT10 Creativity. 					



SPECIFIC SKILLS:

- CE1 Knowledge of the most important physical theories and phenomena.
- CE2 Order of magnitude estimation applied to different physical phenomena.

GOALS (EXPECTED KNOWLEDGE BY THE END OF THE COURSE)

- Understanding of the basic concepts in 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.

CONTENTS

THEORETICAL CONTENTS:

1: Introduction

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

2: Solar system

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

3: Stars

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

4: Galaxies

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

5: Cosmology

- 12. Cosmology: Olbers Paradox. Cosmological redshift. Expansion of the universe. The Cosmic Microwave Background. Evolution of the Universe.



PRACTICAL CONTENTS:

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.
- Paper reading sessions: Reading and discussion of selected astronomical papers on popular scientific journals/magazines.

Laboratory Sessions: These sessions were created as a Innovative Teaching Project of the UGR: *"Using a virtual planetarium for teaching Astronomy"*.

Attendance to the 8 Laboratory practical sessions is **mandatory** to pass the course.

Practice 1. Positional Astronomy. The celestial sphere.

Practice 2. Solar and sidereal day. Analemma.

Practice 3. Determination of planetary masses and distances.

Practice 4. Estimate of the mass of a spiral galaxy.

Outside practice sessions:

Practice 1. Astronomy night in Parque de las Ciencias.

Practice 2. Visit to Sierra Nevada observatories.

Practice 3. Observing night: using a planisphere. Identification of the brightest objects.

BIBLIOGRAPHY

BASIC BIBLIOGRAPHY:

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

COMPLEMENTARY BIBLIOGRAPHY:

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

WWW LINKS

Beyond international year of Astronomy: <http://www.astronomy2009.org/>

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

Learning Activity 1: Acquiring basic astronomical knowledge.

Methods:

- **Lectures:** Classroom lectures in which the lecturer explains the basic topics of the subject. Participation of students is strongly encouraged. Skills CT1, CT8, CE1.
- **Seminars:** Discussion of specific topics of the course. Seminars can be given by invited speakers or by the students (under supervision). Skills CT1, CT2, CT3, CT8, CT10, CE1.
- **Tutorials:** Work on the difficulties/doubts with individual or small group of students. Skills CT1, CT3, CT8, CE1.

Learning Activity 2: Problem solving and practical cases.

Methods:

- **Practical sessions:** Practical sessions with the whole class in which the theoretical contents studied in the classroom are used in practical cases. Skills CT1, CT2, CT3, CT6, CT8, CT10, CE1, CE2.
- **Problem solving sessions:** Sessions in which the students, with the supervision of the professor, learn to solve selected problems related to the topics studied during the lectures. Skills CT1, CT2, CT3, CT6, CT8, CT10, CE1, CE2.
- **Tutoring:** Individual or small group sessions to solve any issue related to the subject. Skills CT1, CT3, CT8, CE1.

Classroom	Lectures	40 % 2,4 ECTS
	Problem solving sessions	
	Practical sessions	
	Seminars	
	Tests	
Non-classroom	Personal study	60 % 3,6 ECTS
	Seminar preparation	

ASSESSMENT (TOOLS, CRITERIA, WEIGHTS, etc)

The student assessment and final score 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 acquired during the course.

The course could only be passed by an average knowledge of all the content covered by the subject. Good knowledge of a fraction of the contents not necessarily compensates lack knowledge of another part.

- Test: 70%
- Seminars/problems/practical sessions: 30%



Passing the practical sessions (having a minimum score of 4) is a necessary condition to pass the course. A score below minimum in practical sessions cannot be compensated by a good score in the test.

Final Assessment Test. 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. The relative weights of both tests and the need of a minimum score in the practical test remains as for the rest of the students.

ADDITIONAL INFORMATION

Tentative dates for the Practical sessions for course 2014/15:

Practice session 1: march 7th & 8th
Practice session 2: april 4th & 5th
Practice session 3: april 25th & 26th
Practice session 4: may 23rd & 24th

Practice sessions take place in the computing rooms of the Faculty of Sciences during the usual lecture hours.



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