VNIVERSITAT DE VALÈNCIA

Course Guide
34261 Astrophysics

COURSE DATA

Data Subject	
Code	34261
Name	Astrophysics
Cycle	Grade
ECTS Credits	4.5
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	3	First term

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	14 - Physics of the earth and the cosmos	Obligatory

Coordination

Name	Department
MARTI PUIG, JOSE MARIA	16 - Astronomy and Astrophysics
MARTINEZ GARCIA, VICENT JOSEP	16 - Astronomy and Astrophysics

SUMMARY

The subject 'Astrophysics' is compulsory and belongs to the module 'Physics of the Earth and the Cosmos'. Its contents are taught during the first semester of the Third Year of the Physics Degree with 4.5 ECTS credits. In 'Astrophysics', the methods and knowledge of modern physics are used to study the movement, structure, composition, and evolution of the celestial bodies in the universe, from the objects of the Solar System to the stars and the galaxies. The course begins presenting basic concepts of positional astronomy to locate the astronomical objects on the celestial sphere and to understand their apparent movements. We also introduce the fundamental techniques of astronomical observation. Further on a description of the Solar System and its components is presented and the discovery of exoplanets is explained. The third theme of the subject is devoted to the study of the stars. The parameters needed to characterize the stars and their structure and evolution are studied. Finally, our galaxy and the other galaxies populating the universe are analysed, introducing highly relevant aspects in current astronomical research such as dark matter, active galaxies, and supermassive black holes. Finally, in the last topic, we present basic notions of Cosmology, the science that studies the universe as a whole, its origin and its evolution, introducing the Big Bang model as well as the current cosmological paradigm supported by present day observations: a flat universe in accelerated expansion.

Those students who wish to expand their knowledge in this field, within the offer of optional subjects in the Physics Degree, should study 'Observational Astrophysics' and 'Relativity and Cosmology' in the Fourth Course.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is required to have completed the first two years of the degree. All the specific subjects of Physics are important for this course. Specific subjects of Mathematics are also important, in particular Integral Calculus and Differential Equations.

It should be emphasized that Astrophysics is, by its very nature, a field of science where most of the specialties of Physics converge.

OUTCOMES

1105 - Degree in Physics

- Knowledge and understanding of the fundamentals of physics in theoretical and experimental aspects, and the mathematical background needed for its formulation.
- To know how to apply the knowledge acquired to professional activity, to know how to solve problems and develop and defend arguments, relying on this knowledge.
- Developing learning skills so as to undertake further studies with a high degree of autonomy.
- Problem solving: be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems .
- Be able to understand and master the use of the most commonly used mathematical and numerical methods.
- Basic & applied Research: acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results.
- Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.

- Comprensión teórica de los fenómenos físicos: Conocer y comprender los fundamentos de la Física, así como del bagaje matemático para su formulación, de los fenómenos físicos involucrados y de las aplicaciones más relevantes.
- Destrezas Generales y Específicas de Lenguas extranjeras: Mejorar el dominio del inglés científico-técnico mediante la lectura y acceso a la bibliografía fundamental de la materia.
- Modelización y resolución de problemas: Saber resolver problemas, siendo capaz de identificar los elementos esenciales de una situación y de realizar las aproximaciones requeridas con objeto de reducir los problemas a un nivel manejable.
- Ser capaz de proseguir con el estudio de otras materias de la física gracias al bagaje adquirido en el contexto de esta materia.
- Cultura General en Física: Haberse familiarizado con los aspectos más importantes de la materia, y con enfoques que abarcan y relacionan diferentes áreas de la física.

LEARNING OUTCOMES

- Problem solving: Being able to clearly assess the orders of magnitude, to develop a perception of situations that are physically different but show analogies, therefore allowing the use of known solutions to new problems.

- Theoretical understanding of physical phenomena: Know and understand the foundations of astrophysics and cosmology, as well as the mathematical baggage for its formulation and the physical phenomena involved and the most relevant applications.

- Modeling and problem solving: Knowing how to solve problems, being able to identify the essential elements of a situation and make the required approximations in order to reduce problems to a manageable level.

- General Culture in Physics: Be familiar with the most important aspects of astrophysics and cosmology, and with approaches that cover and relate different areas of physics.

- General and Specific Foreign Language Skills: Improve the command of scientific-technical English by reading and accessing the fundamental bibliography of the subject.

- Be able to continue studying other subjects in physics thanks to the baggage acquired in the context of this subject.

DESCRIPTION OF CONTENTS

1. POSITION ASTRONOMY

- Coordinate Systems
- Precession, nutation and parallaxes
- Time measurement
- Movement of the stars
- Astronomical observations

2. SOLAR SYSTEM

- Features
- Earth-Moon System
- Rocky and gaseous planets
- Other bodies in the solar system
- Other solar systems: Exoplanets

3. STARS

- Parameters and stellar observation
- Classification of star spectral types
- Empirical relations of stellar parameters
- Binary stars and stellar systems
- Stellar Structure
- Power sources: nuclear reactions
- Transport of energy
- Stellar Evolution
- Pre-main sequence stars and giants
- Novae, supernovae, neutron stars, white dwarfs

4. GALACTIC AND EXTRAGALACTIC ASTRONOMY

- Structure and characteristics of the Galaxy
- Galaxy rotation
- Distance indicators
- Classification of galaxies
- Stellar populations and dark matter
- Active Galaxies and Supermassive Black Holes

5. COSMOLOGY

- Early Universe
- Observational Evidence of the Big Bang model
- Cosmological equations
- Current Paradigm: flat universe accelerated

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Tutorials	7,00	100
Preparation of evaluation activities	15,00	0
Preparing lectures	37,50	0
Preparation of practical classes and problem	15,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

Contact teaching 40%

Theoretical and practical classes: It addresses the conceptual and formal matter and resolution of problems or cases as the application of theoretical concepts. They are based mainly on lectures with dialogue and the use of teaching tools such as experimental demonstrations, animations or videos, graphic solutions, projected presentations, etc.)..

Group tutoring sessions or work in small groups: focus on student work and their active participation: resolving doubts in dealing with theoretical concepts and problem solving, reinforcement in areas of greatest difficulty, questionnaires conceptual , experimental demonstrations relevant to the case studies and associated with a component of continuous assessment, verification of student progress in the field.

Student's personal work 60%

- Study of the theoretical.

- Resolution and problems, multiple choice questions, and works (individually or in groups)

- Individual tutorials: querying of the teacher on student concerns and difficulties encountered in the study and resolution of problems, or discussion on topics of interest, bibliography, etc.

EVALUATION

The assessment system is as follows:

1) Written examinations: One part will assess the understanding of the theoretical-conceptual and formal nature of the subject, both through theoretical questions, conceptual questions and numerical or simple particular cases. Another part will assess the applicability of the formalism, by solving problems and critical capacity regarding the results. Proper argumentations and adequate justifications will be important in both cases.

2) Continuous assessment: assessment of exercises and problems presented by students, questions proposed and discussed in class, oral presentation of problems solved or any other method that involves an interaction with students.

COMMENTS:

The final grade will be the highest of the written exam grade and the result of adding the written exam grade multiplied by 0,7 and the continuous assessment grade multiplied by 0,3.

REFERENCES

Basic

- Carroll, B. W., Ostlie, D. A., An Introduction to Modern Astrophysics, Cambridge University Press, second edition, 2017
- Karttunen, H., Kröger, P., Oja, H., Poutanen, M., Donner, K. J., Fundamental Astronomy, Springer, sixth edition, 2017
- Martínez, V. J., Miralles, J. A., Marco, E., Galadí-Enríquez, D., Astronomía Fundamental, Publicacions de la Universitat de València, 2005
- Lang, K.R, Essential Astrophysics, Springer-Verlag, Berlin, 2013
- Keaton, C., Principles of Astrophysics, Springer-Verlag, New York, 2014

Additional

- Clayton, D. D., Principles of Stellar Evolution and Nucleosynthesis, University of Chicago Press, 1983
- Hansen, C. J., Kawaler, S. D., Stellar Interiors, Springer, 1994
- Kippenhahn, R. Weigert, A., Stellar Structure and Evolution, Springer, 1990
- Rybicki, G. B., Lightman, A. P., Radiative Processes in Astrophysics, Wiley, 1979
- Schneider, P., Extragalactic Astronomy and Cosmology. An Introduction, Springer, second edition, 2015
- Shapiro, S. L., Teukolsky, S. A., Black holes, White Dwarfs and Neutron Stars: The Physics of Compact Objects, Wiley-WCH, 1983
- Shu, F. H., The Physics of Astrophysics. Volume I. Radiation, University Science Books, 1991
- Sparke, L. S., Gallagher, J. S., Galaxies in the Universe. An Introduction, Cambridge, 2000
- Ryden, B., Introduction to Cosmology, Second edition. Cambridge University Press, 2017
- Perlov, B., Vilenkin, A., Cosmology for the Curious, Springer-Verlag, , 2017
- Martínez, V.J., Saar, E., Statistics of the Galaxy Distribution, Chapman & Hall/CRC Press, Boca Raton, 2002.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

TEACHING METHODOLOGY: The hybrid teaching model implemented and the percentage of attendance will be determined by the CAT of the degree based on the available material resources and the existing health conditions and standards.

CONTENTS: The intention is to give all the contents collected in the teaching guide adapting the depth to the possibilities of the implemented teaching model.

EVALUATION: In accordance with the recommendation of the University we have decided to increase the weight of the continuous evaluation to 50% to obtain the final grade.