Last update: 06-05-2019

230488 - ASTRO - Astrophysics and Cosmology

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 748 - FIS - Department of Physics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN ENGINEERING PHYSICS (Syllabus 2011). (Teaching unit Optional)
ECTS credits: 6 Teaching languages: English

Teaching staff

Coordinator: Garcia-Berro Montilla, Enrique

Others: Jose Pont, Jordi

Opening hours

Timetable: By appointment

Prior skills

Those of the bachelor degree.

Requirements

Having passed previous courses.

Degree competences to which the subject contributes

Generical:

3. ABILITY TO IDENTIFY, FORMULATE, AND SOLVE PHYSICAL ENGINEERING PROBLEMS. Planning and solving physical engineering problems with initiative, making decisions and with creativity. Developing methods of analysis and problem solving in a systematic and creative way.

Transversal:

1. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

Teaching methodology

Classical lectures and Project-Based Learning.

Learning objectives of the subject

Study the essential properties of the Universe. Develop mathematical models to describe the properties of astronomical objects. Design the fundamental characteristics of terrestrial and on-board astronomical instrumentation.

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Study load

Total learning time: 150h	Hours large group:	65h	43.33%
	Self study:	85h	56.67%

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Content

1. Introduction

Learning time: 1h

Theory classes: 1h

Description:
An introduction to the course.

Related activities:
None.

Specific objectives:
Provide an overall view of the course: understanding our Universe, with the help of Physical tools.

2. Planets and the Solar System.

Learning time: 16h

Theory classes: 5h
Practical classes: 1h
Self study : 10h

Description:
2. Planets and the Solar System.
2.1. The Solar System.
2.1.1. Terrestrial planets.
2.1.2. Giant planets.
2.2. Exoplanets.

Related activities:
None.

Specific objectives:
Understanding our Solar System and the search for other planetary systems.

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3. Stellar structure.

Learning time: 40h

Theory classes: 10h
Practical classes: 6h
Guided activities: 1h
Self study : 23h

Description:
3.1. Relevant observational characteristics and timescales.
3.2. Stellar interiors
3.2.1. The equations of stellar structure.
3.2.2. Equation of state.
3.2.3. Nuclear physics of stars.
3.2.4. Neutrino losses.
3.2.5. Sources of opacity.
3.3. Stellar atmospheres.

Related activities:
a) Modeling a Sedov explosion.
b) Free fall collapse.
c) Integration of zero temperature white dwarf structures: the mass-radius relationship.

Specific objectives:
Understanding the equations of stellar structure and learning the ingredients necessary to model a star.

4. Stellar evolution.

Learning time: 38h

Theory classes: 9h
Practical classes: 5h
Guided activities: 1h
Self study : 23h

Description:
4.1. The main sequence phase.
4.2. Red giants.
4.3. Stellar remnants: white dwarfs, neutron stars and black holes.
4.4. Stellar explosions: core-collapse supernovae, novae and thermonuclear supernovae.

Related activities:
a) Stellar evolution: from the main sequence to the giant phase (using the TYCHO stellar evolutionary code).
b) Solving a simple nuclear network.

Specific objectives:
Understanding the different evolutionary phases of stars.

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5. The Sun.

Learning time: 15h

Theory classes: 2h
Practical classes: 1h
Self study : 12h

Description:
5.1. The radiative core.
5.1.1. Nuclear reactions.
5.1.2. Neutrino emission.
5.2. Convective layer.
5.3. Atmosphere.
5.3.1. Photosphere.
5.3.2. Chromosphere.
5.3.3. Corona.
5.4. The Solar cycle.
5.5. Solar activity.

Related activities:
None.

Specific objectives:
Understanding the structure and main characteristics of the Sun.

6. Galaxies.

Learning time: 19h

Theory classes: 3h
Practical classes: 3h
Guided activities: 1h
Self study : 12h

Description:
6.1. The Milky Way.
6.2. Morphological classification of galaxies: the Hubble sequence.
6.3. Galactic chemical evolution.
6.4. Active galaxies and quasars.

Related activities:
a) Chemical evolution of the Galaxy: the closed box approximation.

Specific objectives:
Learning the main properties of Galaxies.

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7. Large-scale structure of the Universe.	Learning time: 18h Theory classes: 4h Practical classes: 2h Self study : 12h

Description:
7.1. Clusters of galaxies.
7.2. The extragalactic distance scale.
7.3. The accelerated expansion of the Universe.
7.4. Gamma-ray bursts.

Related activities:
None.

Specific objectives:
Learning the large scale structure of our Universe.

8. Cosmology	Learning time: 21h Theory classes: 5h Practical classes: 2h Self study : 14h

Description:
8.1. The observational basis of modern cosmology.
8.2. The cosmological principle.
8.3. Cosmological models.
8.4. The Big Bang and the inflationary Universe.

Related activities:
None.

Specific objectives:
Understanding the basic tools of modern cosmology.

Qualification system

60% final examination, 40% Project-Based Learning.

Regulations for carrying out activities

To be defined.

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Bibliography

Basic:

Carroll, B.W.; Ostlie, D.A. An introduction to modern astrophysics. 2nd ed. San Francisco: Pearson Addison-Wesley, 2007. ISBN 0805304029.

Karttunen, H. [et al.]. Fundamental astronomy. 5th ed. Berlin [etc.]: Springer, 2007. ISBN 978-3540341437.

Complementary:

Zeilik, M.; Gregory, S.A. Introductory astronomy and astrophysics. 4th ed. Fort Worth: Saunders College, 1998. ISBN 0030062284.

José, Jordi. Stellar Explosions: hydrodynamics and nucleosynthesis. Boca Raton: CRC Press, 2016. ISBN 9781439853061.

Others resources:

Computer material

Ordinador portàtil

Personal laptop computer