UAB
Universitat Autònoma de Barcelona

Planets of the Solar System and Exoplanets: Life in the Universe

Code: 44085
ECTS Credits: 6

2024/2025

Degree	Type	Year
4313861 High Energy Physics, Astrophysics and Cosmology	OT	0

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

Basic knowledge of Physics and Astronomy is strongly advised.

Objectives and Contextualisation

The objective of the course is to provide the student with the basic knowledge on topics related to planets (both Solar System and exoplanets) and life in the universe from a broad perspective.
This includes understanding the processes of planet formation, the structure of planet interiors and atmospheres, the concept habitability in general, techniques for exoplanet detection and characterization, the main characteristics of life on Earth and beyond, and also radiative processes.
The course will make use of theoretical lectures as well as practical work and exercises to be carried out by the students.
Up-to-date literature will be used to complement the topics discussed in class and the student should be able to comprehend the details of the techniques and methodologies used in such publications.
The final goal is that the students acquire sufficient basic knowledge to carry out work in this field of research and, most importantly, that they learn to think by themselves.

Competences

- Formulate and tackle problems, both open and more defined, identifying the most relevant principles and using approaches where necessary to reach a solution, which should be presented with an explanation of the suppositions and approaches.
- Understand the bases of advanced topics selected at the frontier of high energy physics, astrophysics and cosmology and apply them consistently.

Learning Outcomes

1. Acquire general knowledge vision of a multidisciplinary discipline like astrobiology.
2. Analyse the concept of inhabitability from the broadest of perspectives, including physical concepts like energy balance, biological ones, such as terrestrial extremophiles, and chemical ones, such as biomarkers.
3. Master the theoretical and practical concepts related to remote sensing, applied to the Earth and to the characterisation of exoplanets.
4. Understand the general aspects of the formation and structure of the planets, both in the Solar System and in other exoplanetary systems.

Content

- Introduction to stellar evolution and origin of chemical elements
- Formation and evolution of planetary systems
- Radiative processes
- Astrochemistry
- Habitability: definition and feedback mechanisms
- Solar System: water words vs. icy satellites
- Atmospheres and interiors of Solar System planets
- Exoplanet detection
- Observation of exoplanet atmospheres
- Biomarkers and detection of life
- Planet Earth
- Life as we know it
- Earth's biosphere
- Life at the edge: extremophiles

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Oral presentation of a journal paper	2	0.08	1, 2, 4, 3
Theory lectures	41	1.64	1, 2, 4, 3
Type: Supervised			
Participation and discussion	20	0.8	1, 2, 4, 3

Type: Autonomous			
Preparation of an oral presentation on a paper	10	0.4	1, 2, 4, 3
Preparation of exam	20	0.8	1, 2, 4, 3
Preparation of problem sets	52.5	2.1	1, 2, 4, 3

Theory lectures.
Resolving of exercises and problem sets.
Oral presentation of a journal paper.
Active participation in class and attendance to relevant seminars in the campus.
Classwork and homework.

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
Oral presentation of a journal paper	20%	2	0.08	1, 2, 4, 3
Problem sets	30%	0	0	1, 2, 4, 3
Written exam	50%	2.5	0.1	1, 2, 4, 3

The evaluation will consist of three different elements:

1. Written exam that may contain multiple choice or individual questions, developing a topic and/or practical exercises.
2. Oral presentation of a journal paper from the literature.
3. Problem sets to be developed as homework during the course.

This subject/module does not foresee the single assessment system.
50% one final written exam, with different questions covering the main different topics. There will be a resit exam in case of not reaching the minimum total mark of the course

Bibliography

NUCLEOSYNTHESIS AND CHEMICAL ELEMENTS
"Nuclear astrophysics: the unfinished quest for the origin of the elements", Jordi José, Christian Iliadis, 2011, Reports on Progress in Physics, Vol. 74, Issue 9
"Origin of the Chemical Elements", T. Rausher, A. Patkos, (arXiv:1011.5627) in Handbook of Nuclear Chemistry, pp 611-655, Springer

PLANETS AND EXOPLANETS
"Exoplanets", S. Seager (ed.)., 2010, The University of Arizona Press

"Fundamental Planetary Science", J.J. Lissauer. I. de Pater, 2013, Cambridge University Press
"The Exoplanet Handbook", 2014, M. Perryman, Cambridge University Press
"Protostars and Planets VI", H. Beuther et al. (eds), 2014, The University of Arizona Press
"The early evolution of theatmospheres of terrestrial planets", J.M. Trigo-Rodríguez et al., 2013, Springer
"The catalytic potential of cosmic dust: Implications for prebiotic chemistry in the solar nebula and other protoplanetary systems", H.G.M. Hill, J.A. Nuth, 2003, Astrobiology, Vol.3, Num. 2

ASTROBIOLOGY AND LIFE
"An introduction to Astrobiology", I. Gilmour, M.A. Sephton, 1999, The Open University, Cambridge University Press
"Astrobiology. An Introduction", A. Longstaff, 2015, CRC Press
"Life in the universe", D. Schulze-Makuch, L.N. Irwin, 2008, Springer-Verlag

Software

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Language list

Name	Group	Language	Semester	Turn
(TEm) Theory (master)	1	English	second semester	morning-mixed