SUBJECT TEACHING GUIDE

278 - Cosmology

Master's Degree in Particle Physics and the Cosmos

Academic year 2025-2026

1. IDENTIFYING DATA					
Degree	Master's Degree in Particle Physics and the Cosmos			Type and Year	Optional. Year 1
Faculty	Faculty of Sciences				
Discipline	SPECIALIZATION IN PHYSICS OF THE COSMOS Specialisation Module				
Course unit title and code	278 - Cosmology				
Number of ECTS credits allocated	6	Term		Semester based (2)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. FISICA MODERNA
Name of lecturer	JOSE LUIS BERNAL MERA
E-mail	joseluis.bernal@unican.es
Office	
Other lecturers	

3.1 LEARNING OUTCOMES
- To know, and to be able to solve, the Friedmann equations for different cosmological models
- To understand the key moments in the thermic history of the universe
- To know how cosmological structures have formed and evolved from the initial density fluctuation field , and to know how this structure growth is related to the key cosmological parameters
- To acquire a global view of Cosmology
- To know and to understand the role of experimental (observational) cosmology in the framework of the theoretical cosmological models
- To acquire skills and techniques that are necessary to address the current problems in cosmology.

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6. SUBJECT PROGRAM	
CONTENTS	
1	Review of General Relativity
2	Evolution of the Expansion of the Universe (background Einstein Equations, background Boltzmann Equations and cosmography)
3	Thermal history of the Universe and origin of species
4	Cosmological perturbation theory
5	Inflation and Initial conditions
6	Growth of structure and matter distribution
7	Cosmic Microwave background
8	Large scale structure and galaxy surveys
9	Current state of the art in cosmology
10	Defense of essays

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
Written report	Work	Yes	Yes	30,00
Oral presentation	Oral Exam	Yes	Yes	20,00
Classroom activities and exercises	Others	No	Yes	50,00
TOTAL				100,00

Observations
The presentation of the work and the monitoring of face-to-face activities will preferably be carried out in person, with the possibility of carrying out these parts of the evaluation remotely if external circumstances so require. In the written report, any text directly copied from other sources will be considered plagiarism; similarly, the use of artificial intelligence tools for writing the report will not be allow. To pass the subject, the exercises and the written report must be submitted
Observations for part-time students
Students in a part-time regime may be evaluated on the basis of a written work and its subsequent oral presentation (in person or online if circumstances require), in this case having percentages of 70% (written work) and 30% (the presentation of the work). The class notes will be available online, and there will be an open channel of communication via institutional email available for the student

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
Modern Cosmology, Second Edition, Scott Dodelson & Fabian Schmidt, Academic Press, 2021 (Referencia principal de la asignatura)
Theoretical Astrophysics, Vol. III: Galaxies and Cosmology, T. Padmanabhan, Cambridge University Press, 2002
Gravitation and Cosmology, S. Weinberg, New York: Wiley, 1972
Cosmology, S. Weinberg, Oxford University Press, 2008
Cosmological Physics, John A. Peacock, Cambridge University Press, 1999
Cosmological Inflation and Large Scale Structure, A.R. Liddle and D. Lyth, Cambridge University Press, 2000