UAB
Universitat Autònoma de Barcelona

Cosmology

Code: 42858
ECTS Credits: 6

2025/2026

Degree	Type	Year
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

Introduction to the Physics of the Cosmos

Objectives and Contextualisation

The course is intended to provide students with a introductory lectures to Cosmology. The standard Cosmological model, the open questions and the current research lines in the field.

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. Apply the theory of cosmic perturbation to the problem of the formation of the structure of the universe.
2. Distinguish and analyse the problems of the classic Big Bang theory.
3. Recognise the basics of the theory of cosmic perturbation theory.

Content

1) Introduction to the course

2) Practical projects

3) Flash Intro

4) Inflation

5) Baryogenesis

6) Dark matter & Dark Energy

7) Thermal history - Homogeneous Universe

8) Inhomogeneous Universe

9) Gravitational instability - Growth of structure

10) Probes of structure

11) Observational probes

12) Models beyond LCDM

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures on basic concepts	45	1.8	1, 2, 3
Type: Supervised			
Home problems	39	1.56	1, 2, 3
Type: Autonomous			
Class Projects	39	1.56	1, 2, 3

Theory lectures and exercises.

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
Class Project & Problems	50%	21	0.84	1, 2, 3
Exam	50%	3	0.12	1, 2, 3
Resit Exam	50%	3	0.12	1, 2, 3

This subject/module does not foresee the single assessment system.
Attendance to class is a mandatory requirement. 50% of the grade comes from assignments of problems and the completion of a research project in groups. The other 50% comes from a written exam. To be able to participate in the written exam, you must have obtained a grade higher than 3.5/10 in the assignments of problems and the project.

Bibliography

- An introduction to Moderm Cosmology, A.Liddle, Horizon P&D (1999, 2003)
- Modern Cosmology, S. Dodelson, Elsevier (2020)
- Cosmological Physics, J.A.Peacock, Cambridge U. Press (1999)
- Extragalactic Astronomy and Cosmology, Peter Schneider, (2010)
- Introduction to Cosmology, Barbara Sue Ryden (2010)

Software

PART I : Introduction

1) Introduction to the course

2) Practical projects

3) Flash Intro (Homogeneous Universe, GR Equations: Friedmann Eq. and Acceleration scalar & tensor, Metric, Distances, Redshift)

PART II : Standard model problems

4) Inflation (Flatness and Horizon problem, Inflation models and perturbations, Power spectrum and GWs)

5) Baryogenesis (Puzzle of the entropy in the Universe, Some solutions)

6) Dark matter & Dark Energy (Motivation, and some cosmological studies - freeze-out)

PART III: Observational probes

7) Thermal history - Homogeneous Universe (Boltzmann equations, Recombination, Ionization history)

8) Inhomogeneous Universe (CMB temperature, polarization, SZ effect, Sachs-Wolfe effect).

9) Gravitational instability - Growth of structure (Evolution of scales vs. time, Equations of Motion for Perturbations, Solution to Linear Order, Growing Mode / Decaying Mode, Evolution during Matter Domination, Evolution during Radiation Domination -Suppression of Growth, Linear Power Spectrum, Random Fields -skewness / kurtosis, Baryon Acoustic Oscillations)

10) Probes of structure (Gravitational Lensing: Weak lensing and Strong Lensing, Galaxy Formation - Halo model - Numerical simulations, Galaxy clusters - Galaxy clustering)

11) Observational probes (SN Ia/II, BAO, RSD, 3x2pt, 5x2pt, H0/s8 tension)

12) Models beyond LCDM (Modified gravity, Evolving DE)

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

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