SUBJECT TEACHING GUIDE

288 - STANDARD MODEL OF PARTICLE PHYSICS

Master's Degree in Particle Physics and the Cosmos

Academic year 2026 - 2027

1. IDENTIFYING DATA					
Degree	Master's Degree in Particle Physics and the Cosmos			Type and Year	Compulsory. Year 1
Faculty	Faculty of Sciences				
Discipline	PARTICLE PHYSICS AND PHYSICS OF THE COSMOS				
Course unit title and code	288 - STANDARD MODEL OF PARTICLE PHYSICS				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. FISICA MODERNA
Name of lecturer	PABLO MARTINEZ RUIZ DEL ARBOL
E-mail	pablo.martinez@unican.es
Office	IFCA - Edificio Juan Jordá. Planta: - 1. DESPACHO INVESTIGADOR VISITANTE (S121)
Other lecturers	NICOLO TREVISANI

3.1 LEARNING OUTCOMES
To know the Standard Model of Particle Physics
Understand the role of symmetries in Particle Physics
To understand the mathematics of the fundamental interactions
To Be able to perform calculations of physical observables
To understand the precision possible/required in the comparison theory/experiment
To be able to understand the meaning of experimental results and their comparison with theory
To understand the experimental methods used to validate the Standard Model
To Be able to find information on the advance of the theory and experimental results, techniques used in the field, and prepare and defend scientific reports

4. OBJECTIVES
Basic knowledge on Quantum field Theory and the Standard Model of Particle Physics.
Knowledge about the role of symetries in Particle Physics
To be able to perform calculations in the frame of the quantum field theory
To be able to interpret the experimental results and its comparison with theoretical predictions
To know the experimental methods used to validate the Standard Model
To be able to get information about the evolution of the theory, about the experimental results and about analysis techniques.
To be able to prepare and present reports about the topics worked in the course

6. COURSE ORGANIZATION	
CONTENTS	
1	Introduction to quantum field theory, transition rates and cross sections
2	Klein-Gordon's equation and Dirac's equation
3	Interaction as an interchange of particles, gauge theories and quantum electrodynamics
4	Electron-positron anhilition
5	Electron-proton scattering and deep inelastic scattering
6	Simetry and quark model
7	Quantum chromodynamics
8	The weak interaction and the Higgs boson
9	Theories beyond the Standard Model

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessment	%
Deliverable 1	Work	No	Yes	10,00
Deliverable 2	Work	No	Yes	10,00
Deliverable 3	Work	No	Yes	10,00
Deliverable 4	Work	No	Yes	10,00
Deliverable 5	Work	No	Yes	10,00
Deliverable 6	Work	No	Yes	10,00
Deliverable 7	Work	No	Yes	10,00
Deliverable 8	Work	No	Yes	10,00
Deliverable 9	Work	No	Yes	10,00
Oral presentation in class	Others	No	Yes	10,00
TOTAL				100,00
Observations				
The evaluation will be based on the delivery of 9 works proposed in class and associated to each of the chapters of the course. The deadline will be approximately one week since the moment in which the chapter is finished. The exact date will be fixed in that moment. Additionally, it will be necessary to expose one of the works in class during the semester. If any of the deliverables, or the oral presentation is not handed in in time, it will be possible to do it at the end of the semester including the comments received by the teachers. In this case the maximum grade for this deliverable will be 5/10. The use of ilicit methods such as chat-gpt or others will not be permitted.				

Observations for part-time students
If necessary the calendar will be adapted to the availability of the students attending at partial time. For the evaluation, there will be a flexibilization of the deadlines within reason.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Modern Particle Physics, M. Thomson
Nuclear and Particle Physics. B.R. Martin
Particle Physics B. R. Martin