INSTITUTO DE FÍSICA
FACULTAD DE FÍSICA

COURSE	: **ADVANCED QUANTUM MECHANICS I**
TRANSLATION	: MECANICA CUÁTICA AVANZADA I
NUMBER	: FIM8440
CREDITS	: 15 UC/ 9 SCT
MODULES	: 02
REQUISITES	: FIZ0412
CONECTOR	: AND
RESTRICTIONS	: 030401, 030501
CHARACTER	: MINIMUM
FORMAT	: THEORETICAL LECTURES
QUALIFICATION	: STANDARD
DISCIPLINE	: PHYSICS
FORMATE LEVEL	: MAGISTER
KEY WORDS	: QUANTUM MECHANICS

I. COURSE DESCRIPTION

In this course, of a theoretical nature, various advanced aspects of Quantum Mechanics will be discussed, which are not usually included in undergraduate courses. In particular, the fundamental concepts of relativistic Quantum Mechanics, Path Integrals and second quantization are presented, with some introductory scopes to Quantum Field Theory.

II. LEARNING OUTCOMES

1. Familiarize the student with the fundamental concepts of Relativistic Quantum Mechanics, in particular the Dirac equation and its possible solutions.
2. Introduce the concept of Path Integrals, in the context of Quantum Mechanics and Statistical Mechanics.
3. Familiarize the student with the Second Quantization formalism.
4. Present an introduction to Quantum Electrodynamics and Quantum Field Theory.

III. CONTENT

1.- Dirac equation
- 1.1- Introduction: Special Relativity and Lorentz Group.
- 1.2- Klein-Gordon equation
- 1.3- Dirac equation, Dirac matrices and transformations of the Lorentz Group
- 1.4- Free particle type solutions
- 1.5- Coulomb potential and solution of the relativistic hydrogen spectrum

2.- Integral of Feynman Path
- 2.1- Formulation of the path integral from Schrödinger's Hamiltonian.
- 2.2- Examples of calculating path integrals: free particle, harmonic oscillator.

3.- Second quantization and Fock space
- 3.3- Definition of Fock's Space and creation and annihilation operators.
- 3.4- Path integrals in coherent states and applications in many-body quantum theory.

4.- Introduction to Quantum Electrodynamics and Quantum Field Theory

IV. METHODOLOGICAL STRATEGIES

Theoretical lectures

V. EVALUATIVE STRATEGIES

Tests (80%)
Presentation (20%)

VI. BIBLIOGRAPHY

REQUIRED

1. J. D. Bjorken and S. D. Drell, "Relativistic Quantum Mechanics", McGraw-Hill (1998).
2. B. Thaller, "The Dirac Equation", Springer-Verlag (2010).
3. C. Itzykson and J.-B. Zuber, "Quantum Field Theory", McGraw-Hill (1980).
4. J.-J. Sakurai, "Advanced Quantum Mechanics", Addison-Wesley (1967).
5. J. W. Negele and H. Orland, "Quantum Many-Particle Systems". Westview Press (1998).
6. F. Mandl and G. Shaw, "Quantum Field Theory", Wiley (1996).

OPTIONAL
N/A