UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

DIPARTIMENTO INTERUNIVERSITARIO DI FISICA

COURSE OF STUDY *Physics (LM-17)*

ACADEMIC YEAR *2024-2025*

ACADEMIC SUBJECT *Quantum Field Theory*

General information	
Year of the course	*1st*
Academic calendar (starting and ending date)	1st semester: September – December 2024
Credits (CFU/ECTS):	6
SSD	*FIS/02*
Language	English
Mode of attendance	Recommended, not compulsory

Professor/ Lecturer	
Name and Surname	Saverio Pascazio
E-mail	saverio.pascazio@uniba.it
Telephone	080 5443462
Department and address	Physics Department, via Amendola 173, Bari
Virtual room	
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Upon request

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
150	32	30	88
CFU/ECTS			
6	4	2	

Learning Objectives	Understanding the concept of the quantum field theory
Course prerequisites	Quantum Mechanics, Mathematical Methods of Physics

Teaching strategy	Lectures, exercises, comments on methodology
Expected learning outcomes in terms of	
Knowledge and understanding	• Understanding the scientific method, the nature, and the methods of research in Physics • Knowledge of quantum field theory • Knowledge in theoretical physics of fundamental interactions • Knowledge of the interacting quantum fields • Knowledge of the structure of matter, with particular attention to condensed matter and photonics applications • Acquire critical thinking, creativity, analytical ability. • Understand physical phenomena and focus on their precise formulation. • Understand the meaning of the mathematical (most concise) description of the physical world.
Applying knowledge and understanding	• Ability to identify the essential elements of a phenomenon • Ability to use analogy to apply known solutions to new problems (problem solving) • Ability to use analytical and numerical mathematical computation tools • Define objectives, benchmarks, learning targets and standards.

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	● Apply the powerful methods of theoretical physics to other fields and disciplines. ● Acquire the ability to judge correctness. ● Become aware of methods and tools of investigation. ● Stimulate and direct collaborative learning and individual understanding.
Soft skills	● **Making informed judgments and choices** ○ Ability to work with increasing levels of autonomy, including taking responsibility in project planning and managing facilities. ○ Judge the value of acquired knowledge and methods. ○ Estabilish evaluation criteria and standards, both quantitative and qualitative. ○ Compare, contrast, distinguish, describe and finally identify physical phenomena. ● **Communicating knowledge and understanding** ○ Competence in communication in Italian and English in advanced fields of Physics ○ Grasp communication accurately, become able to adopt different and alternative forms of presentation. ○ Master physics and science communication. ○ Make examples that are not misleading and hinder scientific understanding. ● **Capacities to continue learning** ○ Acquisition of basic knowledge tools for continuous learning and knowledge updates ○ Reorganize material in summary, with central meaning and crucial points. ○ Translate, interpret, extrapolate and view relationships. ○ Continuously update scientific knowledge. ○ Ask the right questions.

Syllabus	
Content knowledge	*Many-Body Systems and Classical Field Theory* *Classical and Quantum Mechanics of Particle Systems* *Classical Field Theory* *Canonical Quantization* *Nonrelativistic Quantum Field Theory* *Spin-O Fields: The Klein-Gordon Equation* *Spin-1/2 Fields: The Dirac Equation* *Spin-1 Fields: The Maxwell and Proca Equations* *Quantization of the Photon Field*
Texts and readings	*Walter Greiner & Joachim Reinhardt, Field quantization (Springer Verlag, 1997)* *S. Weinberg, The Quantum Theory of Fields 1: Foundations (Cambridge Univ. Press, 2005).*
Notes, additional materials	*Selected chapters + course lecture notes*
Repository	

Assessment	
Assessment methods	Oral examination
Assessment criteria	● **Knowledge and understanding**

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	○ Demonstrate knowledge and understanding of content and concepts through developed and accurate descriptions, explanations and examples. ● **Applying knowledge and understanding** ○ Apply concepts in practically relevant situations. ● **Autonomy of judgment** ○ Consistently identify and analyze sources and data and consistently identify different views and their implications. ● **Communicating knowledge and understanding** ○ Organize information and ideas effectively and communicate information and ideas in a way that is completely clear. ● **Communication skills** ○ Communicate information and ideas in a way that is completely appropriate to the audience and purpose. ● **Capacities to continue learning** ○ Development of effective continuous assessment instruments and methods, and selection of appropriate continuous assessment instruments and methods.
Final exam and grading criteria	Knowledge of the principles and patterns of quantum field theory and comprehension of the facts and methods of quantum physics.
Further information	