



Università degli Studi della Basilicata

DIPARTIMENTO DI MATEMATICA, INFORMATICA ED ECONOMIA

COURSE: Theoretical Physics			
ACADEMIC YEAR: 2018 / 2019			
TYPE OF EDUCATIONAL ACTIVITY: Characterizing			
TEACHER: D. Cocolicchio			
e-mail:		website:	
phone:		mobile (optional):	
Language of Instruction: Italian			
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ECTS: 6	n. of hours: 48	Campus: Potenza DIPARTIMENTO DI MATEMATICA, INFORMATICA ED ECONOMIA Corso di Laurea Magistrale in Matematica	Semester: II

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

Course Outline and Contents: This course provides a broad introduction and numerous applications in the field of quantum-relativistic physics.

Learning Outcomes: This course aims to introduce the fundamental concepts of quantum relativistic physics, focusing on the most recent discoveries.

PREREQUISITES

This course has been meant for students with a good knowledge of general and modern physics.

SYLLABUS

The course consists of three main parts:

From Analytical Mechanics to Classical Field Theory

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Mathematical Formulations of Relativistic Quantum Mechanics

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The problem of computing Quantum Corrections to Classical Theory

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The canonical and path integral formalism through simple examples

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Basics of Quantum Field Theory

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Covariant Second Quantization of the Electro-Dynamics (QED)

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Quantum Corrections, Feynman Diagrams and the Renormalization Theory

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Non-Abelian Gauge Theories and the Standard Model

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Introduction to quantum many-body theory

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Systems of identical particles. Bose-Einstein and Fermi-Dirac quantum statistical distributions

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Physical Applications of Group Theory

›

Fundamental Particles and associated Unitary Irreducible Representations of the Poincarè Group

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Relativistic Wave Equations: Klein-Gordon, Dirac, Pauli, Proca and Maxwell

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TEACHING METHODS

Teaching Methods and Tools: Class lessons are highlighted by means of a computer assisted approach, with examples in MatLab and MATHEMATICA.

EVALUATION METHODS

Assessment Methods: Oral examination is usually supplemented with a discussion of a homework report.



TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Although, this course is largely based on lecture notes, nevertheless, the following textbooks may be a useful completion.

- G. Costa, G.L. Fogli, *Lorentz group and particles states*, in "Kinematics and symmetry", Text-book on Elementary Particle Physics, ed. M. Nikolic' (1979) Chap. V, pp. 58-165.
- G. Costa, G.L. Fogli, *Internal symmetries*, in "Kinematics and symmetries", Text-book on Elementary Particle Physics, ed. M. Nikolic' (1979) Chap. VI, pp. 167-294.
- A. Lichnerowicz, *"Theorie Relativistes de la Gravitation et de l'Electromagnetisme"* (Masson Ed., Paris, 1955)
- A. O. Barut, *"Electrodynamics and Classical Theory of Fields and Particles"* (Dover Publications, New York, 1980)
- B. Thidé, *"Electromagnetic Field Theory"*, Second Edition (Dover Publications, New York, 2010)
- J.D. Bjorken, S. Drell, *"Relativistic Quantum Mechanics"*, (McGraw-Hill , 1964)
- J.D. Bjorken, S. Drell, *"Relativistic Quantum Fields"*, (McGraw-Hill , 1965)
- P. Ramond, *"Field Theory: A modern Primer"* (Benjamin, 1981)
- C. Itzykson, J.-B. Zuber, *"Quantum Field Theory"* (McGraw-Hill Book, 1980)
- L. H. Ryder, *"Quantum Field Theory"* (Cambridge University Press, Cambridge, 1985)
- M. Peskin, D. Schroeder, *"An Introduction to Quantum Field Theory"* (Perseus Books, 1995)
- F. Mandl, G. Shaw, *"Quantum Field Theory"*, Revised edition (Wiley-Interscience, Chichester, 1993)
- T-P. Cheng, L-F. Li, *"Gauge Theory of Elementary Particle Physics"* (Oxford Univ. Press, 1984)
- L. D. Landau, E. M. Lifshitz, *"The Classical Theory of Fields"*, (Pergamon Press, New York, 1975^{4Ed})
- M. Le Bellac, *"Quantum and Statistical Field Theory"* (Oxford U.P., Oxford, 1992).
- S. Weinberg, *"Teoria quantistica dei campi", vol. I* (Zanichelli, 2000)
- S. Weinberg, *"The quantum theory of fields", vol. II, III* (Cambridge Univ. Press, 1996, 2000)
- W. Greiner, *"Theoretical Physics", vol. 3, 4, 5* (Springer-Verlag, 1992, 1993, 1998)
- L. S. Brown, *"Quantum Field Theory"* (Cambridge University Press, Cambridge, 1992)
- B. S. DeWitt, *"Dynamical Theory of Groups and Fields"* (Gordon and Breach, New York, 1965)
- J. Collins, *"Renormalization"* (Cambridge U.P., Cambridge, 1984)

INTERACTION WITH STUDENTS

EXAMINATION SESSIONS (FORECAST)¹

Month	Year	Day
March	2019	13
June	2019	19
July	2019	17
September	2019	18
October	2019	23
November	2019	27
December	2019	11

SEMINARS BY EXTERNAL EXPERTS YES NO

FURTHER INFORMATION

¹ Subject to possible changes: check the web site for updates.