Basic/Essential Course Information	
Course title	**Foundations of Theoretical Physics I**
Degree Course title	BCS in Physics
ECTS	6
Compulsory attendance	Yes
Course teaching language	ITALIAN

Teacher	Leonardo Angelini	leonardo.angelini@uniba.it

ECTS Details	**Disciplinary area/broad field:**	SSD	Crediti
	Characterizing	FIS/02	6

Time management and teaching activity type	Period	Year	lesson type
	2nd semester	2nd	Lessons (32h) Laboratory (30h)

Teaching organization	Total hours	in-class/in-lab study hours	out-of-class study hours
	150	62	88

Course calendar	Starting date	Ending date
	04.03.2019	06.06.2019

Syllabus	
Prerequisites	Concepts and computational ability in Mathematical Analysis, Linear Algebra, Analytical Mechanics and Classical Mechanics.
Expected learning outcomes (according to Dublin Descriptors)	• ***Knowledge and understanding of:*** Total angular momentum. Spin. Identical particles. Scattering. Central potentials. • ***Applying knowledge and understanding:*** Solving simple problems related to theoretical knowledge. Use of approximate calculation methods: variational method, semiclassical approximation, independent and time-dependent perturbation theory.
Course contents summary	Addition of angular momenta. Electron Spin. Identical particles. Central potentials. Scattering. Approximation methods.
Detailed syllabus	• **Angular Momentum.** Addition of angular momenta. Clebsh-Gordan coefficients. Examples. Parity operator. Parity of eigenstates of the orbital angular moment. Electron spin and its magnetic dipole moment. Exercises. • **Identical particles.** Principle of indistinguishability. Bosons and fermions. Exercises. • **Central Potentials.** Hamiltonian in spherical coordinates.

	Operator radial momentum. The radial equation. Behaviour of radial function in the origin. Radial function for free particle, particle in an impenetrable sphere, particle in a potential well. Expansion of plane waves into spherical waves. Hydrogen-like atom. Exercises. • **Scattering.** Scattering of a wave packet. Green's functions. Born approximation. Partial waves and phase shifts. Resonances. Exercises. • **Perturbation theory.** Time-independent perturbation theory in the absence and presence of degeneration. Stark effect. Fine structure. Time-dependent perturbation theory. Instantaneous perturbation. Periodic perturbation. Exercises. • **WKB method.** Semiclassical approximation. Connection conditions. Bohr-Sommerfeld quantization. Transmission through a potential barrier. Alpha decay. Exercises. • **Variational Method.** Ritz theorem. The ground state of helium. Exercises.
Books	1. G. Nardulli, *Meccanica Quantistica I, Principi*, Franco Angeli, Milano 2001. 2. L. Angelini, *Meccanica Quantistica: problemi scelti,* II edizione, Springer-Verlag Italia, Milano 2018
Notes	Supplementary eaching material is available at www.ba.infn.it\~angelini.
Teaching methods	Lessons / classroom exercises, with blackboard and video projector. Exonerations.
Assessment methods	30% - Written test on problems in text book n. 2.: cap. 3 (da 3.7 a 3.14), 4, 5 (da 5.9 a 5.12), 6, 7, 8, 9 70% - oral examination
Evaluation criteria	The level of knowledge of the expected learning outcomes coincides with the level of exposure of the Syllabus topics in the textbook and in the supplementary teaching material indicated. Similarly, the student must be able to apply the knowledge acquired at the same level used in the above mentioned problem book.
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