COURSE OF STUDY *Physics (LM-17)*

ACADEMIC YEAR *2023-2024*

ACADEMIC SUBJECT *Kinetic Theory of Transport Phenomena*

General information	
Year of the course	1st
Academic calendar (starting and ending date)	2nd semester: March - May 2024
Credits (CFU/ECTS):	6
SSD	CHIM/03
Language	English
Mode of attendance	Recommended, not compulsory

Professor/ Lecturer	
Name and Surname	Savino Longo
E-mail	savino.longo@uniba.it
Telephone	080 5442088
Department and address	Dipartimento di Chimica, Via E. Orabona 4, 70125 Bari (BA)
Virtual room	
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Wednesday 15:00-19:00; it is recommended to contact carla.coppola@uniba.it to be sure of the professor's availability

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
150	40	15	95
CFU/ECTS			
6	5	1	

Learning Objectives	The course teaches to apply the concepts and methods of transport phenomena starting from diffusion theory and elementary kinetic theory to arrive at the most advanced formulations, which find application for example in astrophysics and nuclear energy. It is taught to formulate and solve problems in integral-differential, integral form and using special functions and computer calculations. Advanced mathematical techniques, also useful in various fields of physics, chemistry, and biology, are taught through practice and application rather than by proving theorems.
Course prerequisites	Basic chemistry. Differential equations. Basic computer programming.

Teaching strategies	Lessons with proposal and discussion of cases of study. Development of computational codes.
Expected learning outcomes in terms of	
Knowledge and understanding on:	o Understand the scientific method, the nature, and the methods of research in Physics o Knowledge of statistical mechanics and statistical methods o Use concepts of transport theory to the understanding of systems in physics, plasma physics, astrochemistry, nuclear energy

Applying knowledge and understanding on:	o Ability to identify the essential elements of a phenomenon o Ability to use analogy to apply known solutions to new problems (problem solving) o Ability to use analytical and numerical mathematical computation tools o The students learn how to use powerful mathematical technique developed for transport problems but applicable to many other fields. o The students also learn how to develop, check and use computer programs to solve specific problems.
Soft skills	● **Making informed judgments and choices** o Ability to work with increasing levels of autonomy, including taking responsibility in project planning and managing facilities o Students are encouraged to choose personal solutions to the problems they are facing, and sufficiently elaborate solutions can be the essential part of the exam interview. ● **Communicating knowledge and understanding** o Competence in communication in Italian and English in advanced fields of Physics o Know how to expose the particularities of case studies and propose solution techniques, discussion in the classroom is encouraged ● **Capacities to continue learning** o Acquisition of basic knowledge tools for continuous learning and knowledge updates o Know how to extract operational information for case studies from formal texts
Syllabus	
Content knowledge	Brownian motion and potential theory. Numerical solutions of the steady-state diffusion equation. Boundary conditions. Green functions. Deterministic and Monte Carlo calculations of integrals. The transport equation in integral-differential form. Isotropic and anisotropic scattering. Integral formulations: the Schwarzschild-Milne equation. Properties and uses of Chandrasekhar's H function. Monte Carlo method applied to transport problems. Charged particles dynamics and transport: linear and nonlinear. Applications: photon transport in planetary atmospheres, electron and ion transport in plasmas, nuclear reactors.
Texts and readings	Chandrasekhar, *Radiative Transfer* Smirnov, B. M. *Physics of ionized gases. John Wiley & Sons.* Pitaevskii, L. P., & Lifshitz, E. M. *Physical Kinetics*
Notes, additional materials	Some chapters of each. Scientific papers are also used for special methods and applications.
Repository	

Assessment	
Assessment methods	Oral exam, based on the student's seminar presentation on a case study agreed with the teacher, using a Powerpoint presentation and computer code.
Assessment criteria	The student ● **knows** the principles of transport theory and its application to real problems ● **knows** how to develop method to solve transport equations ● **knows** how to use sound simplification and hypothesis for concrete cases. ● **knows how to realize** a presentation. ● **knows how to present** the results
Final exam and grading criteria	Oral exam (100%)
Further information	
	.