Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

Course catalogue

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Programme of Course "Kinetic and hydrodynamic models"

- Code: DT0254
- Type of course unit: Elective (Master Degree in Mathematics curriculum Generale), Compulsory (Master Degree in Mathematical Engineering curriculum Comune)
- Level of course unit: Postgraduate Degrees
- Semester: 2

Number of ects credits: (Master Degree in Mathematics) 6 (workload 150 hours), (Master Degree in Mathematical Engineering) 6 (workload 150 hours)

Teachers: Matteo Colangeli (matteo.colangeli1@univaq.it)

1	**Course objectives**	This course provides an introduction to the classical kinetic theory of gases and the derivation of hydrodynamic equations. The course also offers an overview on the Monte Carlo simulation techniques. On successful completion of this module the student has the knowledge on the basic principles and the simulation strategies of kinetic models.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • Phase space description, Liouville Theorem and the BBGKY hierarchy. • The Boltzmann Equation and the H-Theorem: the onset of irreversibility. • Methods of reduced description to derive hydrodynamics from kinetic theory: the Hilbert and the Chapman-Enskog expansions. • Hydrodynamic modes, the dispersion relation and the spectrum of density fluctuations. • Basic principles of Monte Carlo simulations. • The Kac ring model On successful completion of this module, the student should : • have a clear overview on how to obtain hydrodynamic conservation laws starting from the Boltzmann equation and should also be able to build up his/her own Monte Carlo code to run stochastic simulations.
3	**Course prerequisites**	Mathematical Analysis
4	**Teaching methodsand language**	**Language**: English **Reference textbooks** • L. E. Reichl, ***A Modern Course in Statistical Physics, 4th Ed.***. John Wiley & Sons,. 2016. • Neal Madras, ***Lectures on Monte Carlo Methods*** . American Mathematical Society. 2002 . • M. E. J. Newman and G. T. Barkema, ***Monte Carlo Methods in Statistical Physics***. Oxford University Press. 2001. • C. Cercignani, ***The Boltzmann equation and its Applications***. Springer-Verlag, New York, . 1988.
5	**Assessment methods**	Written exam with a few general questions regarding the topics treated in the class and presentation of a numerical code for Monte Carlo simulation of a particle system, developed under the guidance of the lecturer.