

## PhD Physics course at Bari University (XXXI Cycle)

<b>Title</b>	Complex System: An introduction
<b>Proponent</b>	Giovanni Ferraro
<b># CFU (1 CFU = 8 hours)</b>	2
<b>Schedule</b>	May 5-6-12-13-19-20-26-27 (11,30-13,30 a.m.)
<b>Brief Summary of the course</b>	The course is a general introduction to complex systems from the physics to the biology. We focus on concepts, ideas, with the aim to clarify some aspects of the behaviour of real systems like feedback, self-organization, phase transitions, emergence and so on. In particular, we refer to some classic papers and scientists who contributed to found complex thinking and modelling.
<b>Programme</b>	<ul style="list-style-type: none"> <li>-Introduction</li> <li>-Before defining a system: generic chemical-physical vs complex one. Equilibrium and non-equilibrium</li> <li>-Boundaries and approximation praise.</li> <li>-More is different! Systems Thinking and Systems Modeling</li> <li>-What is a complex system? Complex Adaptive Systems (CAS): different approaches (Weaver, Santa Fe Institute, ...)</li> <li>-Feedback idea: positive and negative feedback.</li> <li>-Complex Systems Structure: auto-organization, hierarchy, coherence.</li> <li>-Complex System Dynamics: stochastic processes, chaos, non-linear systems, coherent systems having a program, difference between complicated and complex systems.</li> <li>-Reductionist and systemic view: emergence and de-emergence.</li> <li>-Physical laws and role of thermodynamics: wrong paradoxes and deviations.</li> <li>-Applied Systems: physics, chemistry, biology, medicine, ecology.</li> <li>-Laboratory examples.</li> </ul>
<b>Recommended texts</b>	Some papers and books: Ageno, Anderson, Aubin, Bocchi-Ceruti, Dyson, Feynman, Fromm, Gandolfi, Gell-Man, Gleich, Haken, Laughlin, Parisi, Prigogine, Schrodinger, Warren, Wolfram.
<b>Assessment methods</b>	The students are invited to apply some concepts and ideas illustrated during lectures to his PhD research program as a conclusive homework.