

# Dynamical Models in Systems Biology \*\*

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**Calendario:** 16 ore, Lunedì e Mercoledì ore 14.30 - 16.30. Prima lezione il 2 febbraio 2009.  
Aula DEI/G (Piano 3, Dipartimento di Ingegneria dell'Informazione, Via Gradenigo 6/a).

**Prerequisiti:** Basic courses of linear algebra and ODEs.

**Tipologia di esame:** Final project and student seminar.

**Aim:** The course aims at providing an overview of some of the mathematical tools used in the modeling of biological phenomena. The emphasis is on nonlinear models and system analysis, and the examples are mostly from signaling and metabolic pathways.

## Topics:

1. Qualitative analysis of ODE models
  - single and two-species dynamics
  - linear and nonlinear systems, equilibria and (multi)stability, monotonicity
  - oscillations
2. Examples of specific “biological mechanisms”
  - predator-prey models
  - epidemic models (HIV dynamics, kinetic of prion replication)
  - precision (kinetic proofreading)
  - adaptation (bacterial chemotaxis)
  - autoinduction (quorum sensing)
3. Whole network dynamical theories:
  - Stoichiometric network analysis
  - Metabolic control analysis
  - Chemical reaction network theory

## References:

- L. Edelstein-Keshet. “Mathematical Models in Biology”, SIAM Classics, 2005.
- E. Sontag, “Lecture Notes in Mathematical Biology”, available at the URL:  
<http://www.math.rutgers.edu/~sontag/613.html>
- U. Alon, “An Introduction to Systems Biology”, CRC press, 2007.
- B. O. Palsson, “Systems Biology”, Cambridge Univ. Press, 2006.
- E. Klipp, R. Herwig, A. Kowald, C. Wierling, H. Lerhach, “Systems Biology in Practice”, Wiley, 2005.

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