

## AMS 537 / PHY 559 Course outline

Course lecturer: Tom MacCarthy

Room: Laufer Center Seminar Room 101

### Topics

Modeling of chemical reaction networks and biochemical kinetics;  
Michaelis-Menten Equation, Enzyme reactions, Hill equation  
Gene Regulatory Network Models, homodimerizing TFs  
Generalized Mass Action and S-system modeling  
Dynamics/response time of simple gene regulation  
Autoregulation and cooperativity  
Local Stability, Limit cycles, bifurcations  
Network Motifs, Chemotaxis, Kinetic proof-reading  
Self v non-self recognition in immune system  
Optimal gene circuit design  
Optimal regulation in varying environments,  
Glycolysis model and non-dimensionalization  
Network theory: centrality measures, diffusion in networks, random walks  
Population genetics, Hardy Weinberg law  
Irreversible/reversible mutation models  
NK Model and neutral networks

### Reference Books

Brian Ingalls, *Mathematical Modeling in Systems Biology*

Uri Alon, *An introduction to Systems Biology*

M.E.J. Newman, *Networks: an introduction*

Eberhard Voit, *A first course in Systems Biology*