



# Swiss Doctoral Program in Mathematics

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## Cours du semestre d'automne 2009 à l'EPFL

<b>Title</b>	<b>Special topics in biomathematics</b>
<b>Instructor</b>	<b>Jean-Pierre Gabriel, Christian Mazza</b> (Fribourg)
<b>Time</b>	September 16 - December 16, 2009, Wednesday, 11:15 - 12:30
<b>Place</b>	EPF Lausanne, room CM 10
<b>Audience</b>	PhD students, advanced Master students
<b>Content</b>	<p>Today biomathematics covers the integrality of life sciences. We propose a choice of topics based on the research activities of the speakers.</p> <p><b>Mathematical models in systems biology:</b> We present basic notions from systems biology, by focusing on mathematical modelling. We consider stochastic models of gene expression. Gene networks dynamics are modeled using the Gillespie algorithm, a Markov chain describing the time evolution of gene products. We present mathematical results related to small gene networks, as used for example in synthetic biology, and consider large gene networks using mean field models and diffusion approximations.</p> <p><b>Oviposition functions in parasitology:</b> The cycles of some parasitic worms are a major public health problem, e.g. schistosomiasis. We discuss models of such cycles and introduce the notion of oviposition function which capture the way the parasite reproduces. Their characterization will require probability theory and special function theory.</p> <p><b>Voluntary activation of a muscle:</b> This complex process starts with electrical signals produced in our central nervous system which are driven to muscular fibers where they induce contraction. One of the steps along that path is microscopic, and not directly accessible to observation. We describe a model allowing the determination of the unknown quantity by using a macroscopic property of the muscle. The problem will lead to the study of a new type of integral equation.</p> <p><b>Haemodialysis and mathematics:</b> The treatment of kidney failure by dialysis is a source of interesting questions. We treat clinical problems and the dynamics, in zero gravity, of solvent and solutes through membranes.</p>
<b>Evaluation</b>	On request
<b>Prerequisite</b>	basic courses in analysis and probability theory
<b>Info</b>	Ce cours va être réaliser en collaboration avec le 3e Cycle de Statistique et sera donné en français. Contact <a href="mailto:christian.mazza@unifr.ch">christian.mazza@unifr.ch</a>