UCL Université catholique de Louvain

LMAPR2510

2013-2014

Mathematical ecology

5.0 credits	30.0 h + 22.5 h	2q

Teacher(s) :	Hanert Emmanuel ; Deleersnijder Eric ;
Language :	Français
Place of the course	Louvain-la-Neuve
Main themes :	o Population models for one species. Logistic model - Microbial growth models - Age distribution models. o Models of interactions between populations and biodiversity: Prey-predator models Lotka-Volterra system - Competitive exclusion principle - Coexistence o Dynamics of infectious diseases and other case studies o Analysis of the model properties: Stability and bifurcation - Biological oscillators and oscillating reactions - Model order reduction and singular perturbations o Stochastic motion, diffusion and characteristic times o Population dynamics in space-time: Equations of advection-diffusion-reaction - Dynamics of one species in presence of dispersion - Dynamics of several species with dispersion - Nonlinear progressive waves - Effect of the dispersion on populations in competition - Development of motives
Aims :	The objective of this course is to introduce the basic tools that allow to understand and possibly predict the local and non-local, natural and/or artificial/industrial ecological processes. These tools include ordinary differential equations and partial differential equations as well as stochastic differential equations. This course is accessible to students in civil engineering in master, more particularly in master in chemistry and material science, in applied mathematics, in mechanical engineering, in electrical engineering and biomedical engineering, as well as to students in master in sciences and in bioengineering. *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled “Programmes/courses offering this Teaching Unit”.*
Content :	This course is concerned with the mathematical modelling of environmental and ecological processes within the framework of the system theory. It proposes to analyze the properties of key models used in ecology, in particular population models, by considering tools from the system theory, like the Lyapunov stability theory or the singular perturbation theory that allow to characterize the time evolution of systems whose dynamics exhibits slow and fast modes. The studied models inherently refer to the main physics laws, and in particular to the mass conservation notions. Its object is to make the link between the concepts of the theoretical ecology and key environmental challenges like the marine ecosystem or the industrial biological processes involving mixed cultures or that might have to face the presence of contaminants.
Other infos :	Prerequisites This course requires a preliminary background in ordinary differential equations and in partial differential equations. Reference books May R.M., 1973, Stability and Complexity in Model Ecosystems, Princeton University Press Murray J.D., 2002 (3rd ed.), Mathematical Biology (Vol. I & II), Springer Okubo A., 1980, Diffusion and Ecological Problems: Mathematical Models, Springer-Verlag Turchin P., 1998, Quantitative Analysis of Movement - Measuring and Modeling Population Redistribution in Animals and Plants, Sinauer Associates
Cycle and year of study :	> Master [120] in Environmental Science and Management > Master [120] in Physics > Master [120] in Civil Engineering > Master [120] in Computer Science and Engineering > Master [120] in Mathematical Engineering > Master [120] in Mechanical Engineering > Master [120] in Computer Science > Master [120] in Electrical Engineering > Master [120] in Biomedical Engineering > Master [120] in Chemical and Materials Engineering > Master [120] in Electro-mechanical Engineering
Faculty or entity in charge:	FYKI