COURSE OUTLINE

1. GENERAL

SCHOOL	Agricultural Sciences		
ACADEMIC UNIT	BIOSYSTEMS& AGRICULTURAL ENGINEERING		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	BAE 911	**SEMESTER**	9th
COURSE TITLE	Crop Development Simulation		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	
Tutorials	2	
Laboratory	0	
TOTAL	**5**	**5**
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge, Skills Development
PREREQUISITE COURSES:	There are no prerequisite courses
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek .-For Erasmus students in English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Agrobiosystem is an anthropogenic ecosystem that manages food, fuel and crop production and covers 1/4 of the world's land surface. Problems such as greenhouse gas emissions, smog, erosion, soil salinization, water pollution, eutrophication, loss of biodiversity and prevalence of insects and pests are mainly due to inaccurate management of agro-biosystems. Understanding the mechanisms/processes responsible for agrobiosystem degradation could reverse these negative trends and help develop new strategies from gene to field scale. Models are a good tool for describing the response of agroecosystems under different sets of biotic and abiotic scenarios. This course serves as an introduction to the modeling and simulation of agrobiosystems, primarily through simple population dynamics models. These models help in idiotype design, phenotyping, understanding Genotype (G) x Environment (E) x Management (M) interactions, physiological mechanisms of a crop, water and nutrient management, sustainability and precision agriculture , in the prediction of insects, pests and diseases, in soil organic carbon dynamics, in climate impact

assessments, etc. However, to get reliable information from all these models, we need to have a good quality data set.
Upon successful completion of the course, students will be able to:
• Recognize the basic characteristics of a model (causal or probabilistic, linear or nonlinear, continuous or discrete time, etc.)
• Give the general solution of a model, where possible, and simulate it
• Calculate the equilibrium positions of a model and their stability
• To make the phase diagram and bifurcation diagram of a model
• To numerically optimize model parameters

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

At the end of this course the student will have further developed the following general skills:
Search, analysis and synthesis of data and information, also using the necessary technologies
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Generating new research ideas
Respect for the natural environment
Exercise criticism and self-criticism
Promotion of free, creative and inductive thinking

3. SYLLABUS

Theory:
1. The agrobiosystems
• The Biosphere,
• Concepts of systems
2. Systemic properties of agrobiomes, case studies
3. Systems Methodologies
• General systems methodology
• Life cycle assessment
• Biological modeling
•Data analysis
• Steps in Modeling Agrobiosystems
• Classification System
• Time entry functions
• Time output functions
4. Simple models of population dynamics in the agrobiosystem
• Birth-death processes in discrete and continuous time.

• Review of 1st order linear homogeneous differential equations (HDEs) with constant coefficients and 1st order linear homogeneous differential equations with constant coefficients.
5. Models of Interacting Populations: Development and Feedback in Population Biology
• Exponential growth equation
• Accounting equation: The accounting model of population dynamics, its analytical solution and the analysis of its solutions. Fixed points (FP) and their stability in one-state models.
• The Lotka-Voterra predator-prey equation
• Multispecies extension of Lotka-Volterra and Holling – Tanner prey-predator models.
•Phase diagrams, fixed points and periodic trajectories in multistate models.
• Local stability of fixed points in multistate models. Review of the concepts of eigenvector and eigenvalue.
• The dynamics of infection
• Feedback analysis
• Steady state and isocline analysis
6. Conservation of Mass in Natural Resource Systems
• Simple compartmental models with inputs and outputs and their limiting behavior.
• One compartment system
• Two compartment system
• Three compartment system
• Multi-compartment system
7. Oscillations and stability in agrobiosystems
• Simple harmonic motion
• Motion damping
• Damping of forced vibrations
• Forced free vibrations
• Stability testing with the isocline and phase plane methods
8. Linear homogeneous systems of 1st order differences with constant coefficients, their solution and stability. Applications to Leslie models.
9. Introduction to Markov chains.
10. Applications of Markov chains in agrobiosystems.
11. Food chain models in agrobiosystems.
12. Optimization of parameters in agrobiosystems
13. Sustainability
• Sustainable harvesting
• Fisheries management
• Nutrient loading

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face deliveries.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of ICT (power point) in Teaching • Use of ICT (power point) in Laboratory Training • Video presentation • Use of ICT in Communication with students (Learning process support through the electronic platform e-class).
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational*	

Activity	***Semester workload***
Lectures	39
Tutorials	26
Study and literature survey	20
Exams	10
Unguided study	30
Course total	**125**

visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of* *evaluation, summative or conclusive, multiple* *choice questionnaires, short-answer questions,* *open-ended questions, problem solving, written* *work, essay/report, oral examination, public* *presentation, laboratory work, clinical* *examination of patient, art interpretation,* *other* *Specifically-defined evaluation criteria are* *given, and if and where they are accessible to* *students.* 1	1. The main assessment criteria focus on understanding and correlating the knowledge that students gain from the course with knowledge from other courses. The evaluation is continuous and dynamic. It mainly includes short project work, solving problems or answering open questions. Exams are conducted orally or in writing or a combination of the two, with or without pre-examination of the key topics of the course, with or without progressions and by other inventive methods, depending on the dynamics and the needs of the audience

5. RECOMMENDED LITERATURE in Greek

- Βιβλίο [59395586]: Μαθηματικά μοντέλα στη Βιολογία 2η έκδοση, Σγαρδέλης Στέφανος Λεπτομέρειες
- Βιβλίο [50661221]: Περιβαλλοντικά Μοντέλα, 2η Έκδοση, Schnoor Jerald L. Λεπτομέρειες
- Βιβλίο [11441]: Οικολογία, Στάμου Γεώργιος Π. Λεπτομέρειες
- Βιβλίο [33156126]: ΤΑ ΜΑΘΗΜΑΤΙΚΑ ΤΗΣ ΖΩΗΣ, Ian Stewart Λεπτομέρειες
- Βιβλίο [320336]: ΔΟΜΗ ΚΑΙ ΔΥΝΑΜΙΚΗ ΒΙΟΚΟΙΝΟΤΗΤΩΝ, ΓΕΩΡΓΙΟΣ ΣΤΑΜΟΥ Λεπτομέρειες
- Βιβλίο [59303654]: ΜΑΘΗΜΑΤΙΚΗ ΜΟΝΤΕΛΟΠΟΙΗΣΗ, ΣΤΑΥΡΟΣ ΚΟΜΗΝΕΑΣ Λεπτομέρειες
- Modeling Life [Ηλεκτρονικό Βιβλίο], Alan Garfinkel, Jane Shevtsov, Yina Guo, HEAL-Link Springer ebooks, 2017.
- Plant Growth Curves: The Functional Approach to Plant Growth Analysis, Roderick Hunt Publisher: Cambridge University Press; Revised ed. edition (9 Mar. 2010) ISBN-10 : 0521427746, ISBN-13 : 978-0521427746
  https://www.amazon.de/-/en/Roderick-Hunt/dp/0521427746