MASTER 'S PROGRAMME
APPLIED MATHEMATICS - IN ENGLISH
1ST YEAR OF STUDY, 2ND SEMESTER

COURSE TITLE	DIFFERENTIAL SYSTEMS AND APPLICATIONS
COURSE CODE	**MA2SDA**
COURSE TYPE	full attendance/ tutorial
COURSE LEVEL	2nd cycle (master's degree)
YEAR OF STUDY, SEMESTER	1st year of study, 2nd semester
NUMBER OF ECTS CREDITS	**7**
NUMBER OF HOURS PER WEEK	4 (2 lecture hours + 2 seminar hours)
NAME OF LECTURE HOLDER	Dr. Anița Sebastian
NAME OF SEMINAR HOLDER	Dr. Anița Sebastian
PREREQUISITES	Curriculum: Differential Equations Language: advanced level of English

A GENERAL AND COURSE-SPECIFIC COMPETENCES

General competences:

- ✓ Show a responsible attitude towards the scientific and didactic field, optimal and creative valorization of their own potential, acting in accordance to the principles and norms of professional ethics
- ✓ Efficient and effective deployment of organized team activities, coordination and effective management of activities organized in a team or in an interdisciplinary group
- ✓ Selection of information resources, efficient use of the sources of professional training, development of the ability to correlate professional activity to the requirements of a dynamic society

Course-specific competences:

- ✓ Data processing, analysis and interpretation using mathematical, statistical and computer tools
- ✓ Use notions, advanced mathematical methods and techniques
- ✓ Develop and analyse methods and algorithms to solve problems
- ✓ Conceive and apply mathematical models to describe real world phenomena
- ✓ Prove the theoretical results using appropriate mathematical methods
- ✓ Use specific scientific research methods and techniques

B LEARNING OUTCOMES

After successfully completing this course, the students will be able to:

- ✓ Describes different phenomena in science and economics using differential equation systems
- ✓ Use theoretical results to establish new qualitative results for solutions to differential systems
- ✓ Use theoretical results to study optimal control issues associated with economic models
- ✓ Use Matlab to highlight the properties of solutions of differential systems and to approximate the optimal control in case of optimal control problems

C LECTURE CONTENT

1. Classical mathematical models of population dynamics described by differential and integro-differential equations. Stability of steady states
2. Discrete models of population dynamics. Stability of steady states
3. Continuous mathematical models of interacting populations
4. Mathematical models in epidemics
5. Age-structured population dynamics with logistic term and migration
6. Existence, uniqueness and positivity of the solution to the linear age-structured population dynamics
7. Asymptotic behaviour of the solution to the linear age-structured population dynamics

	8. The optimal harvesting problem. Existence of an optimal control 9. The optimal harvesting problem. The structure of an optimal control 10. The mathematical model of economic growth with Cobb-Douglas production function 11. The mathematical model of economic growth with S-shaped production function 12. Profit maximization problems 13. Reaction-diffusion systems in chemistry 14. Reaction-diffusion systems in physics
D	**RECOMMENDED READING FOR LECTURES**
	1. Anița,V. Arnăutu, V. Capasso, An Introduction to Optimal Control Problems in Life Sciences and Economics, Birkhauser, 2011 2. V. Barbu, Ecuaţii diferenţiale, Editura Junimea, Iaşi, 1985 3. H. Brezis, Analyse Fonctionnelle, Dunod, 2005
E	**SEMINAR CONTENT**
	1. Classical models of population dynamics. Numerical simulation with Matlab 2. Classical models of population dynamics. Asymptotic behaviour of the solutions. Numerical simulation with Matlab 3. Lotka-Volterra's model and prey-predator model. Numerical simulation with Matlab 4. Asymptotic behaviour of the solutions to the SIR and SIS models. Numerical simulation with Matlab 5. Age-structured population dynamics with logistic term and migration. Numerical simulation with Matlab 6. Age-structured population dynamics with logistic term and migration. Numerical simulation with Matlab 7. Discrete models for interacting populations. Numerical simulation with Matlab 8. Optimal harvesting problems. Optimality conditions 9. Optimal harvesting problems. Numerical simulation with Matlab 10. The mathematical model of economic growth with Cobb-Douglas production function. Matlab simulation 11. The mathematical model of economic growth with S-shaped production function. Matlab simulation 12. Optimal control problems in economics. Matlab simulation 13. Reaction-diffusion systems in chemistry. Matlab simulation 14. Reaction-diffusion systems in physics. Matlab simulation
F	**RECOMMENDED READING FOR SEMINARS**
	1. Anița,V. Arnăutu, V. Capasso, An Introduction to Optimal Control Problems in Life Sciences and Economics, Birkhauser, 2011
G	**EDUCATION STYLE**
LEARNING AND TEACHING METHODS	Lectures: blackboard presentation, proof Seminars/laboratory: exercises, PC simulations, dialogue
ASSESSMENT METHODS	Course: weight in the final grade 50% (final examination) Seminary: weight in the final grade 50% (class activity/evaluation during the semester) Minimal requirements: 1. Defining notions, stating and applying fundamental theoretical results to solving simple problems 2. Identifying and using the appropriate methods to investigate some real world problems 3. Proving studied mathematical results with medium difficulty 4. Minimum grade 5
LANGUAGE OF INSTRUCTION	English