Program		Type of studies (cycle)	Third cycle
		Name of the program	SEE Doctoral Studies in Mathematical Sciences

Course					
Course title		Continuous Dynamical Systems			
Course code	Semester	Course status		ECTS credits	Contact hours
	II			10	30
Teaching staff	Teacher		Prof. Dr. Mustafa Kulenović		
	Other staff		Prof. Dr. Senada Kalabušić, Prof. Dr. Ognyan Christov		
Course goals		The goal of the course is to give to the students a basic knowledge about dynamical systems and a qualitative insight to differential equations.			

Course content/topics

Review of basic concepts and theorems in ODE. Vector fields, flows, linear systems,
fixed points, linearization, phase portraits, stability
Floquet theorem, logarithm of the matrix
Poincare maps. Examples. Duffing equation
Equivalence, equivalence of linear systems. Hartman - Grobman's theorem.
Limit sets. Poincare – Bendixson theorem.
Normal forms. Resonances. Poincare theorem.
Center manifolds. Approximate computations.
Bifurcation of fixed points. A zero eigenvalue. Hopf bifurcation.
Attractors. Lorenz, Rosler and Chua attractors.

LITERATURE

[1] V. I. Arnold, "Ordinary differential equations", various editions.
[2] K.T. Alligood, T.D. Sauer, J.A. Yorke, Chaos (An Introduction to Dynamical Systems), Springer, 1996.
[3] J. Guckenheimer, P. Holmes, Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields, Springer, 1983.
[4] S. Lynch, Dynamical systems with applications using Mathematica, BirkhÄauser, 2007.
[5] G. Teschl, Ordinary Differential Equations and Dynamical Systems, Springer, 2009.
[6] M. Hirsh, S. Smale, R. Devaney, Differential equations, dynamical systems and an introduction to chaos, Elsevier, 2004.
[7] Robert L. Devaney, An Introduction to Chaotic Dynamical Systems, 2nd edition, 2003.
[8] Saber N. Elaydi, Discrete Chaos, Chapman-Hall/CRC, 2000.
[9] M.R.S. Kulenovi´c, O. Merino, Discrete Dynamical Systems and Difference Equations with Mathematica, Chapman-Hall/CRC, 2002.
[10] C. Robinson, Dynamical Systems, CRC, 2nd edition, 1999.
[11] S. Wiggins, Introduction to applied nonlinear dynamical systems and chaos, Springer, 2003.

Grading

	Criterion	Points	Cut-off points
1.	Homework assignment	20	10
2.	Project	30	15
3	Final exam	50	30
	Total	100	55