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

Course

Course title	Dynamical Systems			
Course code	Semester	Course status	ECTS credits	Contact hours
	I		10	30

Teaching staff	Teacher	Prof. Dr. Senada Kalabušić
	Other staff	Doc. Dr. Esmir Pilav
Course goals	The goal of the course is to give to the students a basic knowledge about discrete and continuous dynamical systems.	

Course content/topics

Introduction to Continuous Dynamical Systems: Phase space, vector fields, flows;
Cauchy-Peano existence theorem, uniqueness theorem; Dependence on initial conditions and parameters;
Compact differentiable manifolds where local flows are global flows.
Introduction to Discrete Dynamical Systems: Iteration of maps, fixed points and stability;
Chaotic behavior Bernoulli shift, Cat Map
Nonlinear Systems near Equilibrium: Linearization, Hartman-Grobman Theorem,
Stable manifold Theorem, Almost Periodic Systems
Bifurcation Theory: Center manifold Theorem; Saddle-node bifurcation; Pitchfork bifurcation;
Hopf bifurcation
Structural stability: Smale's horseshoe; Hyperbolic systems
KAM theory, area preserving twist maps, Poincaré's conjecture and Birkhoff's proof,
Aubry-Mather theory, hyperbolic dynamics

LITERATURE

[1] V.I.Arnold, Geometric methods in Ordinary Differential Equatiuons
[2] V.I. Arnold, Ordinary Differential Equations
[3] D. K. Arrowsmith and C. M. Place, An Introduction to Dynamical Systems
[4] C. Chicone, Ordinary Differential Equations and Applications
[5] E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations
[6] J. Guckenheimer and P. Holmes, Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields (Note: this text includes a chapter on chaos.)
[7] A. Katok and B. Hasselblatt, Introduction to the Modern theory of Dynamical Systems
[8] S. Wiggins, Introduction to applied nonlinear dynamical systems and chaos, Springer, 2003.
[9] M. Hirsh, S. Smale, R. Devaney, Differential equations, dynamical systems and an introduction to chaos, Elsevier, 2004.

Grading

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