COURSE SYLLABUS

University	**Alexandru Ioan Cuza University of Iaşi**	**Course title**	
Faculty	**Physics**	**CHAOTIC PHENOMENA AND CONTROL METHODS**	
Department	**Physics**		
Domain	**Physics**	**Course category** (FC/SC/CC[1]): FC	**Term** (1-4): 3
Level	**Postgraduate (MA)**	**Course type** (Co/El/F[2]): Co	

I. Course structure

Number of hours/week				Credits	Total class hours/ semester	Total hours of individual activity	Examination type (C/Ex/CE[3])	Teaching language
Course	Seminar	Lab.	Project	**6**	**56**	**124**	**Ex**	**English**
28		**28**						

II. Instructors

	Academic degree[4]	Scientific degree	Name and surname	Faculty position (tenure/ associate - organization)
Course	Assoc. Prof.	PhD.	DIMITRIU DAN-GHEORGHE	Tenure
Seminar				
Laboratory	Assoc. Prof.	PhD.	DIMITRIU DAN-GHEORGHE	Tenure

III. Prerequisites

Chaos and self-organization

IV. Course objectives

The students become accustomed with the main characteristics of the chaotic phenomena and with the main methods of chaos control. The students will develop their abilities to apply specific techniques for the chaotic phenomena diagnosis. The students will develop practical abilities to use specialized software for the chaotic signal analysis. The student will develop abilities to interdisciplinary approach the study of complex phenomena in laboratory and nature.

V. Course content

Course	General characteristics of chaotic systems. Route of transition to chaos (by intermittency, by quasi-periodicity, by period-doubling). Quantities for chaotic states characterization (Lyapunov exponents, Kolmogorov-Sinai entropy, correlation dimension, information dimension, capacity dimension, fractal dimensions, mutual information, etc.). Chaotic systems examples. The bifurcations control. The chaos control by feedback methods (Ott-Grebogi-Yorke method, Pyragas method). The chaos control by synchronization. The chaos control by parametric perturbations. The intelligent chaos control (by neuronal networks, by adaptive fuzzy logic methods). Experimental chaos control (in plasma, laser, chemical medium, biological systems). The chaos anti-control.
Seminar	
Laboratory	Experimental analysis of two scenarios of transition to chaos in plasma (by type I intermittency and by cascade of period-doubling bifurcations – Feigenbaum scenario). Analysis of turbulence in plasma and liquids. Experimental analysis of uncorrelated dynamics of some complex space charge structures in plasma. Flicker noise analysis. Analysis of noise influence on some nonlinear phenomena in plasma. Chaotic signal analysis by specialized software. Chaos control in plasma by using external circuit elements (capacitors, coils). Experimental analysis of some instabilities in plasma and fluids.

VI. Minimal required references

1. A. H. Nayfeh, B. Balachandran – Applied nonlinear dynamics – Analytical, computational, and experimental mehods, John Wiley & Sons, 1995;

[1] FC – fundamental course, SC – specialty course, CC – complementary course
[2] Co – compulsory, El – elective, F – facultative
[3] C – colloquium, Ex – exam, CE – colloquium AND exam
[4] Professor / Associate professor / Lecturer / Assistant professor / Teaching assistant

2. J. C. Sprott – Chaos and time series analysis, Oxford University Press, 2003;
3. H. G. Schuster (ed.) – Handbook of chaos control 2nd Edition, Wiley-VCH, 2008.

VII. Didactic methods

Exposure, conversation, university lecture, synthetic analysis, demonstration, experiment, simulation

VIII. Assessment

Pre-conditions	Attendance and active participation to all laboratory activities.	
Exam dates	**1st Assessment**	**8th week**
	2nd Assessment	**16th week**

	Assessment means and methods	**Percentage of the final grade**
Exam/Colloquium	Written and oral	70%
Seminar		
Laboratory	Laboratory colloquium	30%