

COURSE OUTLINE

1. GENERAL

SCHOOL			
DEPARTMENT	DEPARTMENT OF PHYSICS		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	CHE711-2023	SEMESTER	7th Semester
COURSE TITLE	Nonlinear dynamics - Chaos Theory		
TEACHING ACTIVITIES If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.		TEACHING HOURS PER WEEK	ECTS CREDITS
		4	5.0
COURSE TYPE Background, General Knowledge, Scientific Area, Skill Development	Scientific Area		
PREREQUISITES			
TEACHING & EXAMINATION LANGUAGE:	Greek		
COURSE OFFERED TO ERASMUS STUDENTS:	YES		
COURSE URL:	https://eclass.emt.duth.gr/		

2. LEARNING OUTCOMES

Learning Outcomes Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.
This course develops systematically the theory of nonlinear dynamics and chaos theory. Nonlinear phenomena are presented in the frame of physics but also within other disciplines such as biology, chemistry, climatology and economics. Upon successful completion of the course the student will have: • Basic knowledge of chaos theory and nonlinear systems and their application to physical systems. And it will have acquired the: • Ability to apply this knowledge to solve relevant complex problems. • Ability to think critically so that they can evaluate, analyze and relate this knowledge. • Ability to interpret phenomena of everyday life. • Ability to develop collaboration with other fellow students to solve problems related to this course

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,
ICT Use, Adaptation to new situations,
Decision making,
Autonomous work,
Teamwork,
Working in an international environment,
Working in an interdisciplinary environment, Production of new research ideas

Project design and management
Equity and Inclusion
Respect for the natural environment
Sustainability
Demonstration of social, professional and moral responsibility and sensitivity to gender issues
Critical thinking
Promoting free, creative and inductive reasoning

Search, analysis and synthesis of data and information, ICT Use
Autonomous work
Teamwork
Critical thinking
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3. COURSE CONTENT

Dynamical systems as continuous flows in phase space and as visualizations.
Equilibrium points and stability.
Branches in one-dimensional systems.
Introduction to chaotic dynamics.
One-dimensional visualizations-Accounting image-Period doubling branch.
Bernoulli shift and definition of chaos.
Two-dimensional visualizations.
Fixed, periodic points and their stability.
Poincaré–Bendixson theorem.
Boundary circles - Hopf bifurcation - Stability of boundary circles - Smale's horseshoe.
Lorenz's System - The Henon Illustration.
Chaotic attractors.
Lyapunov exponents.
Chaos in conserving systems- The standard illustration.
Examples-Applications.

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD Face to face, Distance learning, etc.	Face to face
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) Use of ICT in Teaching, in Laboratory Education, in Communication with students	Use of ICT in Teaching Use of ICT in Communication with students

TEACHING ORGANIZATION The ways and methods of teaching are described in detail. Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research& analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc. The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards	<table border="1"> <thead> <tr> <th>Activity</th><th>Workload/semester</th></tr> </thead> <tbody> <tr> <td>Lectures</td><td>52</td></tr> <tr> <td>Bibliographic research & analysis</td><td>53</td></tr> <tr> <td>Laboratory Exercise</td><td>20</td></tr> <tr> <td>Total</td><td>125</td></tr> </tbody> </table>	Activity	Workload/semester	Lectures	52	Bibliographic research & analysis	53	Laboratory Exercise	20	Total	125
Activity	Workload/semester										
Lectures	52										
Bibliographic research & analysis	53										
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Total	125										
STUDENT EVALUATION Description of the evaluation process Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others Please indicate all relevant information about the course assessment and how students are informed	Student evaluation languages Greek English Method (Formative or Concluding) Formative Student evaluation methods Written Assignment or Written Exam with Problem Solving Written Exam with Short Answer Questions Rate 100 or 40 60										

5. Suggested Bibliography

Chaos and Nonlinear Dynamics, Robert Hilborn 2nd edition
Nonlinear Dynamics and Chaos, Steven Strogatz
Chaos and Timeseries Analysis, Julien Sprott

Eudoxus

ΕΙΣΑΓΩΓΗ ΣΤΑ ΜΗ ΓΡΑΜΜΙΚΑ ΔΥΝΑΜΙΚΑ ΣΥΣΤΗΜΑΤΑ

Κωδικός Βιβλίου στον Εύδοξο: 320107

Έκδοση: 1/2016

Συγγραφείς: ΓΕΩΡΓΙΟΣ ΒΟΥΓΙΑΤΖΗΣ, ΕΥΘΥΜΙΑ ΜΕΛΕΤΑΙΔΟΥ

ISBN: 978-960-603-103-8

Τύπος: Ηλεκτρονικό Βιβλίο

Διαθέτης (Εκδότης): Ελληνικά Ακαδημαϊκά Ηλεκτρονικά Συγγράμματα και Βοηθήματα - Αποθετήριο "Κάλλιπος"

ΔΥΝΑΜΙΚΑ ΣΥΣΤΗΜΑΤΑ ΚΑΙ ΧΑΟΣ

Κωδικός Βιβλίου στον Εύδοξο: 9617

Έκδοση: 1η εκδ./1995

Συγγραφείς: Μπούνη της Αναστάσιος

ISBN: 9789607510228

Τύπος: Σύγγραμμα

Διαθέτης (Εκδότης): Α. ΠΑΠΑΣΩΤΗΡΙΟΥ & ΣΙΑ Ι.Κ.Ε.

Ειδικά θέματα μη γραμμικής δυναμικής και εφαρμογές

Κωδικός Βιβλίου στον Εύδοξο: 127532923

Έκδοση: 1

Συγγραφείς: Μαάιτα, Τζαμάλ-Οδυσσέας

ISBN: 9786182281451

Τύπος: Ηλεκτρονικό Βιβλίο

Διαθέτης (Εκδότης): ΚΑΛΛΙΠΟΣ Ανοικτές Ακαδημαϊκές Εκδόσεις