COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF MATHEMATICS		
LEVEL OF STUDIES	UNDERGRADUATE PROGRAM		
COURSE CODE	**311-0266**	**SEMESTER**	**F**
COURSE TITLE	CLASSICAL MECHANICS		
INSTRUCTOR	Agapitos Hatzinikitas		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	6

COURSE TYPE	Special background
PREREQUISITE COURSES:	NO
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.math.aegean.gr/index.php/en/academics/undergraduate-programs

(2) LEARNING OUTCOMES

Learning outcomes

The student is exposed in basic principles of Classical Mechanics, being able to recognize fundamental classes of mechanical systems and their fundamental principles (such as conservation laws, and least action principles). The student will be able to apply variational methods for the derivation of equations of motions governing basic mechanical systems. Furthermore, the student will be exposed to modern approaches of dynamics, such as the notions of phase space and phase flows.

After completing this course, students should demonstrate competency in the following skills:

- To rationally analyze fundamental mechanical systems
- To demonstrate substantial background on variational methods, focused in problems of mechanics
- To demonstrate substantial background in modern approaches of mechanicς, based on the theory of dynamical systems for the analysis of the relevant induced flows.

General Competences

Working independently. Team working. Working in an interdisciplinary environment. Decision-making. Production of free, creative and inductive thinking.

(3) SYLLABUS

Newton equations of motion. Conservative forces. Conservation laws. Galilean transformations.

Introduction to the calculus of variations (the notion of functional, variation of a functional, necessary conditions for the existence of extremals).

Examples in the calculus of variations.

An introduction to Lagrangian mechanics. The notion of generalized coordinates. Lagrangians and Hamilton’s principle. Euler-Lagrange equations.

An introduction to symmetries. Noether’s theorem. Energy and momentum conservation. Problem and examples. The notion of constraints and Lagrange multipliers. Systems with moving constraints and non-conservation of energy. Euler-Lagrange equations for moving constraints. Examples. Hamiltonian Mechanics. Hamiltonian and canonical equations (Hamilton’s equations). Introduction to the notion of phase space. Phase plain, phase orbits, the notion of flow. The phase plain of conservative systems The structure of the phase space for Hamilton’s canonical equations. Examples for Hamiltonian systems in the plane. An introduction to the notion of canonical transformations. Liouville’s theorem. The generating functions approach. An introduction to Hamilton-Jacobi (HJ) equations. The time-independent HJ equations. Comments on the notion of integrable systems. The notion of Poisson brackets and symplectic matrices.

TEACHING MATERIAL DISTRIBUTION	The teaching material of the course is uniformly distributed during the semester.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	• Communication with students via e-mail. • Potential case studies with suitable symbolic and numerical computations scientific software.
TEACHING METHODS	see table below
COURSE COMMITMENTS	Attending course is not obligatory.
STUDENT PERFORMANCE EVALUATION	Student’s performance is evaluated in Greek, by a written examination paper which includes short-answer questions and problem solving. Disabled students are evaluated by suitably structured examinations (pending on the disability of the student, e.g., oral exams, etc.).

Activity	***Semester workload***
Lectures	52
Independent study	98
Course total (25 per ECTS)	***150***

(5) ATTACHED BIBLIOGRAPHY

1. R. Douglas Gregory. *Classical Mechanics*. Cambridge University Press, 2006.
2. M. R. Spiegel. Theory and Problems of Theoretical Mechanics. *Schaum's Outline Series, McGraw Hill, 1980.*

- *Related academic journals:* Academic journals devoted to Mathematical Physics, Nonlinear Physics, and Nonlinear Science.