M2AM FLUIDS AND DYNAMICS

Dr. G.A. PAVLIOTIS
DEPARTMENT OF MATHEMATICS
IMPERIAL COLLEGE LONDON
HUXLEY 621
g.pavliotis@imperial.co.uk

February 22, 2010

LECTURES

- Tuesdays 14:00-15:00 (Huxley 130).
- Wednesdays 10:00-12:00 (Huxley 130).

PROBLEMS CLASS

- Tuesdays 15:00-16:00 (Huxley 341).

OFFICE HOURS

- Wednesdays 12:00-14:00.
- By appointment.

COURSE WEBPAGE

`http://www.ma.ic.ac.uk/~pavl/M2AM.htm`

- Information about the course.
- Lecture notes (written by Dr. J. GIBBONS).
- Problems sheets (at the end of chapters 2, 3 and 4 of the lecture notes) and solutions.
- Bibliography.

BOOKS/LECTURE NOTES

- We will follow J. GIBBONS' lecture notes.

- L.D. Landau and E.M. Lifschitz, Mechanics (Pergamon Press, Oxford 1976).

- Kibble and Berkshire, Classical Mechanics (Longman 1996).

- Goldstein, Classical Mechanics (Addison-Wesley 1980).

- Arnold, Mathematical Methods for Classical Mechanics (Springer 1980).

- D.D. Holm, Geometric Mechanics (IC Press 2008).

CONTENTS

- This is an introductory course on **analytical dynamics** (Newton, Euler, Lagrange, Hamilton, Poisson, Jacobi, Poincare.....).

- We will study (mostly) Newton's equations of motion and the **Lagrangian** and **Hamiltonian formulation** of classical (Newtonian) mechanics.

- We will see how we can rewrite the equations of classical mechanics as a **variational problem**.

- We will introduce the concept of a **conserved quantity** (**integral of motion**) and show their connection between conserved quantities and **symmetries** of the dynamics.

- We will itroduce the concept of an **integrable system** and show how we can integrate the equations of motion an integrable Hamiltonian system.

Course Objectives

- To learn about variational principles (very useful tool in many applications).

- To learn about Lagrangian and Hamiltonian mechanics (appear in many applications in physics, chemistry, economics....)

- To learn how to use mathematical tools in order to formulate problems in physics: This your first course in Mathematical Physics!

COURSE OUTLINE

- Calculus of variations.
- Lagrangian Mechanics.
- Conserved quantities and Noether's theorem.
- Hamiltonian Mechanics.
- Integrable systems and the Liouville-Arnold theorem.