THE UNIVERSITY OF SYDNEY
Course Information Sheet

Semester 2 | **AMH2: Integrable Systems** | 2014

Lecturers: Sarah Lobb, Milena Radnovic (Room 630, Carslaw Building)

Lecture day and time: Wednesday 10am-12pm

Subject homepage URL: http://www.maths.usyd.edu.au/u/UG/HM/AMH2/

Handbook entry URL: http://www.maths.usyd.edu.au/u/UG/HM/coordinator/applied2014.pdf

Consultation: By appointment - please arrange via e-mail to either sarah.lobb@sydney.edu.au or milena.radnovic@sydney.edu.au

Outline: Integrable systems lie at the boundary of mathematics and physics. The classical integrable systems appeared in the works of great mathematicians such as Euler, Liouville and Jacobi. The theory was revived as soliton theory in the XXth century, introducing new techniques into the field.

In this course, we will study the mathematical properties of both continuous and discrete integrable systems. We will see partial differential and difference equations and their relations; construct soliton solutions; perform symmetry reductions to the Painlevé equations; and identify various aspects of integrability.

We will present geometrical and dynamical properties of some famous integrable systems: elliptical billiards, geodesics on ellipsoids, and some integrable cases of the rigid body motion. We will introduce elliptic curves as a tool in analysis of those systems.

Learning outcomes: By the end of the course you should:

- understand the transformation theory that relates integrable systems to each other;
- be able to use transformations to find discrete integrable systems and their solutions;
- be able to identify key properties of integrable systems;
- understand how the dynamics of some classical integrable systems is transferred to elliptic curve;
- be able to calculate solutions in terms of elliptic functions;
- be able to describe geometic and dynamical properties of the solutions.

Assessment: There will be 4 assignments during the semester (50%), and a take-home exam at the end of the semester (50%).

References and supporting material: Some suggested supplementary texts for this course are:

- V. Arnold, *Mathematical Methods of Classical Mechanics*, Graduate Texts in Mathematics, vol. 60, Springer (1997).
- V. Dragović, M. Radnović, *Poncelet porisms and beyond*, Frontiers in Mathematics, Springer-Birkhauser (2011).
- M. Noumi, *Painlevé equations through symmetry*, American Mathematical Society, Providence, R.I., USA (2004).

Assumed prerequisite knowledge: Basic knowledge of differential equations and linear algebra.