

# Pathways Lecture Series in Mathematics, KEIO

**Speaker : Prof. Mark Groves**  
( Loughborough University )

**Place : 12-209, 2nd Floor, Building 12**  
**Faculty of Science and Technology**  
**Yagami Campus, Keio University**

**Lecture 1** 10:00-12:00, 14:00-16:00, March 4, 2008

**Lecture 2** 10:00-12:00, 14:00-16:00, March 5, 2008

**Lecture 3** 10:00-12:00, 14:00-16:00, March 7, 2008

## Dynamical systems methods for water waves

The gravity-capillary water-wave problem concerns the flow of a perfect fluid subject to the forces of gravity and surface tension; the fluid is bounded below by a rigid horizontal bottom and above by a free surface. In these lectures we formulate several versions of the problem as a Hamiltonian system with infinitely many degrees of freedom and use generalisations of results from the classical theory of dynamical systems to obtain solutions. Topics include:

*Travelling waves with vorticity* Travelling waves are stationary in a frame of reference moving with the wave. We find such waves by reducing a formulation of the hydrodynamic problem as a spatial Hamiltonian system to an equivalent finite-dimensional problem.

*Standing waves* Standing waves are periodic in space and time. We compute the Birkhoff normal form of the appropriate Hamiltonian formulation of this problem and use it to describe standing waves.

*Doubly periodic travelling waves* Doubly periodic waves are periodic in two distinct horizontal directions (both of which can be different to the direction of propagation). We use a variational argument to develop an existence theory for such waves.