School of Mathematics

Course 481 — Introduction to Mathematical Neuroscience 2006-07
(JS/SS Mathematics, SS Theoretical Physics, MSc in HPC.)

Lecturer: Conor Houghton.

Requirements/prerequisites: There are no formal pre-requisites, but the course will assume a knowledge of Freshman mathematics.

Duration: Half-year course running in the second term.

Number of lectures per week: 3

Assessment: There will be a number of small projects.

End-of-year Examination: 2-hour end of year exam.

Description:

Mathematical neuroscience, as a whole, is divided into three main areas, one of which relates to the dynamics of neurons themselves, another to networks of neurons and a third to what people in the field call neural encoding and decoding, the study of how stimulus and response are related in neurons.

This course will consider each of areas in turn. It will begin with a general introduction to neuroscience and no prior knowledge of neurobiology will be assumed. Next, the voltage dynamics of neurons will be considered with a description of the Hodkin-Huxley equation and integrate-and-fire models. Spike train statistics will then be considered, along with the neural code, correllation and reverse correllation methods and stochastic properties. These ideas will be illustrated with an introduction to the visual system. Finally, neuronal plasticity and simple network models will be discussed.

Textbook: The course will be based on Peter Dayan and L.F. Abbot (2001) Theoretical Neuroscience and will cover most of chapters 5, 1, 2 and 7.

September 15, 2006