Instructor: Yoichiro Mori (www.math.umn.edu/~ymori)
Office: VinH 539; email: ymori@math.umn.edu
Office Hours: TBA
Textbooks: We will draw material from the book:
James Keener and James Sneyd, Mathematical Physiology, Springer
An electronic copy is available from the library website. Additional course notes will be posted on instructor’s website.

Course Description: Mathematical physiology is a large field, as large as physiology itself. In this class we will focus on physiology of electrical activity and ionic homeostasis. In the first half of the course, we will study the fundamentals of mathematical electrophysiology. In particular, we will discuss the Hodgkin-Huxley model of action potential propagation, arguably the most important and successful model in all of (mathematical) biology. The second half of the course will be devoted to specific organ systems including cardiac, renal and gastrointestinal systems. Below is a tentative list of topics to be covered.

1. Membrane Potential and Cell Volume Control
   (a) Current Voltage Relationship and the Membrane Potential
   (b) Cell Volume Control
2. Action Potential
   (a) Hodgkin-Huxley Model
   (b) FitzHugh-Nagumo Model and Phase Plane Analysis
3. Cable Model and Wave Propagation
   (a) Front Propagation in the Allen-Cahn Equation
   (b) Action Potential Propagation along an Axon
   (c) Higher Dimension and Curvature Effects
4. Cardiac Electrophysiology
5. Renal Physiology
   (a) Tubuloglomerular Feedback
   (b) Countercurrent Multiplication Mechanism

6. Gastrointestinal Physiology
   (a) Gastric Protection and Fluid Absorption
   (b) Coordination of Contraction

The course does not presuppose any background in biology. The course assumes familiarity with differential equations but will introduce the requisite techniques (homogenization, matched asymptotics, phase plane methods) as the need arises.

**Grading** Grading will be based on the completion of homework assignments given on a biweekly basis.