Obligatoriske oppgaver i INF-5610

Frist: 2. October, kl 14.00

- Red blood cells have a passive exchanger that exchanges a single Cl^- ion for a bicarbonate (HCO_3^-) ion. Develop a model for this exchanger and find the flux.

  Hint: What sort of transport is this an example of?

- Consider the model of the Na^+ channel shown in Fig. 3.14 on page 79(107) in the kompendium. Show that if α and β are large compared to γ and δ, then x_{21} is given (approximately) by

$$x_{21} = \left(\frac{\alpha}{\alpha+\beta}\right)^2 h, \tag{1}$$

$$\frac{dh}{dt} = \gamma(1-h) - \delta h, \tag{2}$$

  while conversely, if γ and δ are large compared to α and β, then (approximately)

$$x_{21} = m^2 \left(\frac{\gamma}{\gamma+\delta}\right), \tag{3}$$

$$\frac{dm}{dt} = \alpha(1-m) - \beta m. \tag{4}$$

  Hint: Use the assumption of equilibrium.

- Explain why replacing the extracellular sodium with choline has little effect on the resting potential of an axon. Why is the same not true if potassium is replaced?

- The Hodkin-Huxley equations are for the squid axon at 6.3^oC. The absolute temperature enters the equations through the Nernst equation. Simulate the equations at 0^oC and 30^oC to determine whether the equations become more or less excitable with an increase in temperature. Use the Matlab code from `http://folk.uio.no/glennli/INF-5610/oblig.m`. The figure below shows a phase-plot for the reduced system. Trajectories for different temperatures are shown. Relate this plot to your conclusions from the simulations.