

The incomplete Jacobi elliptic functions in a mathematica Physics Problem and in a mathematica Biology Problem

FD, OL, CP

The incomplete Jacobi function K appears in explicit solutions in two new problems.

The first Problem is the coupling between the stationary neutronics diffusion equation and the thermohydraulics Systems of equations. Under simple but relevant forms of the coefficients of the neutronics equation, one obtains the ODE for the Jacobi equation and this Analysis provides a much more precise Analysis than most of the numerical methods used for coupling codes. Moreover, the algebraic structure of the underlying elliptic curves proves a nice description of the solution in three General case.

The Second Problem deals with the electrostatics in ions in a biological cell. This problem couples the electrostatic diffusion equation for the electrical potential in the cell with the spreading of the ions inside this cell, modelled by a diffusion equation for the density of each species. In a 1d set-up, this system boils down to a Jacobi equation for the density of ions, and one deduces the electrostatic potential as well as the boundary layer where the ions are present, giving a new interpretation to the Gouy-Chapman boundary layer.