This thesis aims to study the Navier-Stokes-Fourier problem with the entropy equation. In particular, we want to define the notion of a solution and prove its existence. We approach this problem by modifying techniques used in several papers studying the generalized NSF system and the entropy equality and we want to conclude similar results. We are treating the two-dimensional case as opposed to the more frequent 3D case, hence we were able to relax conditions on the initial data.

Firstly, we formulate the definition of a weak solution and impose sufficient conditions to prove its existence. In particular, we will require a bound $p \geq 2$ for the power-law index of the Cauchy stress tensor. Next, we show that there exists a solution to Navier-Stokes-Fourier system (u, ϑ) fulfilling our definition. Lastly, we show that this solution additionally fulfills the entropy equality for $\eta = \log \vartheta$.