This thesis is dedicated to a problem of heat transport where radiation is taken into account. Models for such setting, although complicated, are very important for industrial purposes.

We provide a derivation and explanation of the fundamental physical model for radiative heat transport. The resulting system of radiative transfer equations (RTE) is then approximated with so-called $\mathrm{SP_n}$ equations. Here, we focus on asymptotically deriving a simple set of $\mathrm{SP_1}$ equations. Special attention is given to Marsak-type boundary conditions which we formulate in a more precise form than other sources.

Inspired by the float-glass forming process, we look into problems with multiple domains with different refractive indices. For such an arrangement, there is a need for transition conditions describing the behaviour of the solutions on the interface between two domains of interest. By following an analogous procedure as for the boundary conditions, we have managed to identify a natural set of transition conditions that allow for discontinuity in the intensity variable. To our best knowledge, these conditions have not been yet presented in the literature.

Finally, we present several numerical experiments of solving these equations in *Wolfram Mathematica* software and compare them with benchmark results.