

## Questions for state doctoral exam – field of study: Chemical and Process Engineering

### Subtopic: Heat transport/Heat Processes

1. Heat conduction, Fourier law. Fourier equation, derivation for general control volume. Steady-state conduction in a rod with circular cross-section, Biot number.
2. Transport of heat through surface with ribs, fin approximation, effectiveness of heat exchange across surface with ribs.
3. Combined transport of heat by conduction and convection. Derivation of Fourier-Kirchhoff equation, Péclet number. Continuity of temperature and heat flux at the interface of different temperature zones.
4. Nusselt number, qualitative description of entering and developed region of laminar flow in a tube. Expression for Nusselt number in entering and developed region.
5. Transport of heat at slow flow around a sphere,  $Pe \rightarrow 0$ . Temperature and velocity sublayers, Prandtl number.
6. Free (natural) convection, dynamic pressure, volumetric temperature expansivity, Boussinesq approximation. Mass, momentum and heat balances in systems with free convection.
7. Transport of heat in turbulent flow, temperature fluctuations, time-averaged Fourier-Kirchhoff equations. Constitutive equation for turbulent heat flow.
8. Transport of heat at boiling of liquids, regimes and phases of boiling, boiling in systems with stagnant fluid.
9. Transport of heat at vapor condensation, film condensation on a vertical wall.
10. Heat radiation, Stefan-Boltzmann law, Planck law, black body, heat transfer in radiation between two absolute black body surfaces, view factor.