Discipline: **Chemical Engineering**

Candidate's Profile:

The person eligible to apply for admission to the CUT Doctoral School in the scientific discipline of chemical engineering must have the professional title of Master or equivalent in one of the following study programmes: Chemistry, Chemical Technology, Chemical Engineering, Biotechnology, Nanotechnology, Structural Chemistry, Materials Engineering or Environmental Engineering.

Conditions of the entrance examination

- Examination based on a set of 20 questions/problem-solving tasks – date of the examination according to the time schedule of the CUT DS recruitment process;
- Candidate interview (on *inter alia* the individual research plan) – only those persons will be admitted who have obtained no less than 50% of the total possible score in the examination
- date of the interview according to the time schedule of the CUT DS recruitment process;

Problem areas for the entrance examination:

- Ideal gas and real gases. Functions of state and their mutual interrelations. Principles of thermodynamics.
- Chemical balances (including the influence of pressure and temperature). Thermodynamic parameters of reactions.
- Phase transitions. Phase diagrams – examples and interpretation. Thermodynamic description of mixtures.
- Fundamentals of quantum mechanics. Fundamental particles. The structure of atom. Chemical bonds. The structure of particles.
- Molecular orbitals. Density functional theory.
- Rotational and oscillatory spectroscopy (physical essence and its application in identification of chemical compounds structures).
- Nuclear magnetic resonance spectroscopy (physical essence, chemical shifts, spin systems, spin-spin couplings).
- Diffraction techniques in chemical compounds identification. Electrical and magnetic properties of particles.
- Colloids and surfactants. Motion of particles and ions in gases and liquids. Diffusion.
- Fundamentals of chemical reactions kinetics (rate constant, reaction order, reaction molecularity).
- Activation parameters – the Arrhenius and the Eyring Equations. Transition state theory.
- Simple and complex reactions. Critical Structures. Catalysis.
- Adsorption and diffusion. Electrochemical processes.