

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.