

QUALIFICATION DESCRIPTION

of the PhD program "Processes and Apparatuses in Chemical and Biochemical Technology"
Professional field 4.2 "Chemical Sciences"
at the Institute of Chemical Engineering – BAS

Educational and Scientific Degree	PhD degree
Form of Education	Full time / Part-time / Self-study / Under Art. 21, para. 7 of the Higher Education Act
Duration of Study	Full time up to 3 years / Part-time up to 4 years/ Self-study and under Art. 21, para. 7 of the Higher Education Act up to 5 years

1. Thematic scope

The Institute of Chemical Engineering at Bulgarian Academy of Sciences (ICHe-BAS) implements a consistent policy of integrating scientific research with the training of doctoral students, with the doctoral program "Processes and Apparatuses in Chemical and Biochemical Technology" being directly related to the main scientific directions of the Institute.

The IChE-BAS develops interdisciplinary and application-oriented research, corresponding to the contemporary priorities in the field of sustainable development, circular economy, clean energy and biotechnologies. A significant part of the scientific activity aims at sustainable chemical and biotechnological processes, including the development and optimization of biorefineries for the transformation of plant, waste and algal biomass into energy carriers, biofuels, bioplastics and bioactive products with high benefit. The priority research fields are fermentation and biocatalytic processes, biotechnological synthesis of organic chemicals and the application of "green" methods for extraction and purification, including membrane and supercritical technologies.

An important direction is the process engineering and modeling, covering the study of mass and heat transfer, the development of integrated and resource-efficient technological schemes, as well as modeling and optimization of apparatuses and systems using modern numerical methods, including CFD. These studies contribute to increasing the energy and resource efficiency of chemical and biochemical production.

A significant part of the research is dedicated to clean and renewable energy, including solar thermal and geothermal systems, thermal accumulators, phase transition materials and energy storage technologies. Solutions for the integration of renewable sources, the use of waste heat and sustainable technologies for the production, storage and distribution of hydrogen are also being developed.

In the field of environmental engineering, innovative methods for water and gas purification, bioelectrochemical systems, microbial fuel cells and technologies for the treatment

and valorization of waste materials are being developed. In parallel, research is being developed in the field of chemistry and analysis of foods, natural products and functional ingredients, including the study of bioactive substances with pharmacological and nutraceutical potential and the development of functional foods based on sustainable use of waste raw materials.

Integration between education and research is carried out through regular scientific seminars, colloquiums and internal discussions, at which doctoral students present the results of their research and receive expert feedback. Doctoral students actively participate in national and international scientific projects, mobility programs and cooperation with foreign scientific organizations, which supports the application of scientific results, the development of practical skills and their integration into the international scientific community. Through participation in centers of competence and interdisciplinary projects, the Institute contributes to the transfer of knowledge and technology to industry and society.

Results of the implementation of this policy are presented in scientific publications, participation in international conferences, successfully implemented projects and defended PhD dissertations, which prove the effective connection between scientific research and training in the doctoral program.

1. Training objectives

Research training: Preparation of highly qualified personnel for conducting independent fundamental and applied research in the field of chemical and biochemical engineering.

Innovative solutions: Development of new methods for increasing the efficiency and sustainability of heat and mass transfer processes (absorption, adsorption, distillation).

Modeling and management: Mastering modern methods for mathematical modeling, simulation and optimal management of production systems and supply chains.

2. Key Competencies and Skills

PhD students acquire in-depth knowledge and practical skills in the following areas:

- Processes and Apparatus: Design and optimization of heat and mass transfer apparatus and reactors for chemical and biotechnological production.
- Sustainable Technologies: Development of biotechnologies for biofuel production, decarbonization and wastewater treatment technologies.
- Scientific Ethics and Communication: Ability to prepare scientific publications, present results at international forums and manage scientific projects.

3. Areas of scientific research

Mass and heat transfer in fluid-solid systems and membrane processes.

Mass and heat transfer in fluid-fluid systems.

Bioprocess engineering and scaling of bioreactors.

Chemical and microbiological fuel cells for energy production.

Applied thermodynamics and phase equilibrium in multicomponent mixtures.

4. Professional realization

Graduates of the "PhD" degree from this program are prepared for:

Teaching: Academic career in higher education institutions.

Scientific work: Researchers in institutes of the Bulgarian Academy of Sciences or international research centers.

Industry: Management and expert positions in the chemical, pharmaceutical and biotechnology industries, as well as in R&D departments.

The program at IChE - BAS is accredited until the beginning of 2027, which guarantees compliance with state quality requirements.

Additional information on the websites of the Doctoral School in the PhD Training Center at Bulgarian Academy of Sciences (www.edu.bas.bg) and IChE-BAS (www.iche.bas.bg).

Approved by decision of the National Council of IChE-BAS with protocol №3 of 09.02.2026.

Director:

Prof. DSc. Kaloyan Petrov

