Description of the specialization

I. DEVELOPMENT OF (BIO)TECHNOLOGICAL PROCESSES TO PRODUCE INNOVATIVE (BIO)PRODUCTS

Development of biological systems (including those from the field of genetic and metabolic engineering and bioinformatics), construction and modelling of effective biotechnological tools and analytical techniques for the identification and testing of properties of bioproducts.

Biomass and waste as a medium for the production of new tools for the purposes of biotechnology (including cultures of macro-and microalgae, bacteria, fungi and other organisms).

Development of new sources of biocatalysts and unique metabolites, construction and modelling of effective biocatalytic tools for the biosynthesis and bioconversion processes, biorefining
and biotransformation and for the purposes of processes used in the environmental protection.

Development of bioprocesses based on the use of biomass and waste from the agri-food, forestry and wood and herbal industries, in order to obtain substrates for different industries,
including chemical, cosmetic, pharmaceutical, agricultural, textile, packaging, cellulose and paper industries, and for the manufacture of other products.

Biorefining of renewable raw materials, including waste from the agri-food, forestry and wood and herbal industries (using micro-organisms, including microalgae and microscopic fungi), for their comprehensive management and use in the production of value added compounds.

Innovative technologies to obtain biofuels, feed protein and biocomponents.

Biotechnological methods of obtaining substrates for the production of polymers and products of specialist chemistry as well as processes for their purification and processing.

Technologies using renewable natural resources for the production of plant protection products, fertilisers, biostimulators and surfactants with improved properties.

Technology for the production of bioactive materials for medical and

multifunctional applications
for the purposes of various branches of the economy.

Bionic engineering in the processes of modification and functionalisation of polymeric materials (including bionics of designs, structures, material characteristics, biochemical processes, biological immunity, ergonomics and other phenomena).

Biodegradation of polymeric materials for the production of biologically active oligomers
and new polymer structures.

Processes for the synthesis and modification of biodegradable polymers from renewable, petrochemical and waste raw materials (including industrial, agricultural and municipal).

Development of modern processes for purification of biotechnology products and specialist chemical products.

Modern unit operations in advanced technological processes.

Synthesis and biosynthesis technologies for specialist intermediates used in the production processes of biologically active plant protection agents, biocidal products and veterinary medicinal products.

Technologies using renewable raw materials for the production of monomers and polymers and plastics using these polymers.

II. ADVANCED BIOMASS PROCESSING FOR SPECIALIST CHEMICAL PRODUCTS

1. Production of specialist market products from plant and animal raw materials and their derivatives through chemical, physico-chemical or biochemical processes.
2. Use of by-products from biomass processing to produce specialist products.
3. Production of specialist products through biotechnological and chemical biomass processing and production of intermediates to support such processing.
4. Use of renewable raw materials in the synthesis of polymers and plastics using these polymers.
5. Efficient biomass management in thermal processes
6. Efficient methods of biomass processing into biochar for the purposes of agriculture, industry and wastewater treatment plants
7. Development and use in practice of complex processing technologies of plant, animal and waste raw materials from the agri-food, chemical, energy industries, waste water treatment plants, landfills etc. to produce intermediates for further

processing for the chemical, pharmaceutical, household chemical and other industries.

8. Production technologies aimed at extending the product chain, producing new or improved materials and chemical and biochemical products covering the entire lifecycle.

III. BIOPRODUCTS AND PRODUCTS OF SPECIALIST CHEMISTRY

1. Dietetic and medicinal products and food additives of plant (including extracts from
   from herbal, fibrous and oilseed plants), animal and microbiological origin.
2. Innovative, efficient technologies for the production, processing, refining and modification of natural fibres and fibres from renewable raw materials.
3. Polymer and polymer and fibrous composites, including those with plant raw materials, bionanocomposites, integrated multilayer and multifunctional composites.
4. Nano -and microfibres, fibrous nanomaterials, bionanocoatings and multilayer compositions produced using modern processing techniques from biopolymers and thermoplastic polymers (including natural polymers, biothermoplastics and synthetic polymer equivalents).
5. Innovative (bio)polymers and (bio)plastics (including biodegradable polymers from renewable raw materials and petrochemical raw materials, microbiologically synthesised polymers, synthesised polymers with biocatalysts, natural thermoplastic polymerss, polymers with bioactive and biomedical properties, natural-synthetic polymer compositions, biosensoric polymers).
6. Technologies for the processing of polymers and biopolymers for technical consumer goods (films, paper
   and cardboard, fibres, unwoven fabrics, injection moulds, composite products), processing techniques
   from polymer solutions and alloys, searching for and application of safe, efficient solvents (organic, inorganic, ionic).
7. Modern methods for the production of specialist (bio)polymers using radiation techniques (grafting and networking) intended for specialist products such as, *inter alia*, films, insulation, microfoams, heat-shrinkable polymers, coatings, as well as medical applications.
8. Modern functional additives in polymer materials production technologies to improve their functional properties.
9. Fibrous biomaterials and innovative polymer materials for specialist technical, hygienic, medical, agricultural and other applications.

10. Biosensors (including polymer and polymer-fibrous sensors, textronics, biomimetic sensors, bioelectronic sensors, biocomposite sensor systems.
11. New and generic biologically active substances for the production of plant protection products, biocides and veterinary medicinal products (search for new biological activities, production and processing technologies, extraction and biotransformation technologies, formulations).
12. Development of bioformulations in terms of their applications in biosynthesis, biocatalysis, biomass and waste processing, and in the production of products.
13. Innovative auxiliary agents and additives used in the chemical, biochemical production and in downstream processing, new specialist additives to polymer and biopolymer materials.
14. Bioagrochemicals, biofertilisers and soil improvers, plant growth-stimulating fertilisers, slow-action fertilisers, agrobiosorbents, biological preparations keeping nutrients in the root layer of crops in soil, microbiological vaccines, biopesticides, biosurfactants.
15. New technologies for the production of biocatalysts and homo-heterogeneous catalysts
    with the high selectivity and viability for technological processes.

IV. MODERN BIOTECHNOLOGIES IN THE ENVIRONMENTAL PROTECTION

1. Biological methods for removal of fatty and petroleum pollutants, biodegradation of organic substances of anthropogenic origin in waste streams.
2. Modern fermentation processes for processing of waste from the agri-food industry and municipal waste.
3. Biohydrometallurgical process for removal or recovery of metals from municipal waste (urban mining) and industrial waste.
4. Preventing eutrophication processes by removal of phosphorus and/or nitrogen compounds from aquatic ecosystems, municipal and industrial wastewater.
5. Development and implementation of new technologies of bio- and phytoremediation of the water-ground environment.
6. Integration of biological and physico-chemical processes in treatment of industrial wastewater, allowing to close the water circulation system/recovery of water and energy.
7. Development of deodorisation methods for municipal, industrial waste and livestock manure.
8. Technologies for cleaning waste gases emitted into the air.
9. Technologies for cleaning industrial process and waste gases for their use.
10. Biological methods of the protection against pests in agricultural and forestry crops, food storage and sanitary hygiene (pheromones, repellents, biopesticides,

others).