University of Ss. Cyril and Methodius in Trnava
Námestie Jozefa Herdu 2
917 01 Trnava

EDUCATIONAL OBJECTIVES AND OUTPUTS

Part A: Information on the study programme

Faculty/Institute	Faculty of Natural Sciences, University of Ss. Cyril and Methodius			
Field of study	4. Biotechnology			
Study programme	Biotechnology			
Level of study	Master			
Academic degree	☐ Bc.	☒ Mgr.	☐ Ing.	☐ PhD.
Form of study	☒ full-time		☐ part-time	
Language	English			
Place of education	Faculty of Natural Sciences, University of SS. Cyril and Methodius in Trnava			

Part B: Defining the objectives and outcomes of education in relation to the profile subjects of the study programme

Educational objectives		**Educational objectives description**		
		Educational outcomes		
Study semester	**Profile subject**	**Acquired knowledge***	**Acquired skills***	**Acquired competencies and transferable competencies***
Semester 1	Molecular Biology Techniques	**x**		
	Molecular Biotechnology	**x**		
	Laboratory Exercise in Advanced Molecular Biology Techniques		**x**	
Semester 2	Industrial Biotechnology	**x**		
	Laboratory Exercise in Industrial Biotechnology		**x**	
	Biofuels and Renewable Products	**x**		
	Laboratory Exercise for Diploma Thesis I			**x**
Semester 3	Fundamentals of Bioengineering			**x**
	in vitro Plant Systems	**x**		

	Laboratory Exercise on *in vitro* Plant Systems		**x**	
	Novel and Functional Foods			**x**
	Laboratory Exercise for Diploma Thesis II			**x**
Semester 4	Laboratory Exercise for Diploma Thesis III			**x**

* Knowledge, skills, competencies, and transferable competencies are mentioned only in those profile subjects that lead to their acquisition. It is not necessary to list all types of educational outcomes for each profile subject, and conversely, if we get all outcomes with a profile subject, they are listed in each column.

The aim of studying in the master study programme Biotechnology is the development of intellectual and creative abilities, practical skills of the student.

The graduate by completing the course **Molecular Biological Techniques**:

- will obtain knowledge and overview of selected areas of molecular biology, especially basic methods of DNA analysis,
- will acquire know the basic techniques for the analysis and characterisation of nucleic acid molecules (fragments),
- will be able to design and implement molecular biology procedures for the analysis of nucleic acid molecules, in particular DNA, for example in the construction of recombinant DNA and the production of recombinant proteins,
- will acquire knowledge of the nature, principles and methods of performing selected major techniques of molecular biotechnology used in particular when working with DNA and RNA. These include hybridization and amplification techniques, DNA sequencing techniques (1st to 3rd generation), quantitative DNA analysis, DNA expression analysis, DNA microarrays,
- will gain knowledge of highly variable regions of DNA and their use in forensic analysis of human DNA and forensic analysis of environmental samples, genetic and cytogenetic mapping, gene editing techniques.

The graduate of the **Molecular Biotechnology** subject

- will gain knowledge about the essence, principles and methods of preparation of recombinant DNA molecules, production of recombinant proteins, about the ways of use and application of techniques for the preparation of recombinant DNA molecules, or production of recombinant proteins,
- will understand the principles of preparation of recombinant DNA molecules and production of recombinant proteins in various prokaryotic and eukaryotic host systems both *in vitro* and *in vivo,*
- will gain knowledge of the current and prospective applications of these techniques and the products produced by them in various industries, in pharmacy and medicine, in agriculture, food and energy,
- will be able to design and implement biotechnological experiments and procedures for the preparation of recombinant DNA molecules and the subsequent production of recombinant proteins,
- will be able to apply theoretical knowledge in laboratory activities or in production practice,
- will be able to design and plan his/her own procedures for the creation of recombinant organisms (both prokaryotic and eukaryotic), methods and procedures for their cultivation and production of the required recombinant proteins, respectively RNA and DNA proteins.

After successful completion of the **Industrial Biotechnology** subject, the graduate

- can describe the basic steps of biotechnological production of selected industrial products, raw materials used for production,
- will be able to identify the organism or enzyme to be used in a given stage of production, as well as the actual applicability of the target products,
- will explain the principles of the methods used in the processing of feedstock,

- be able to manage the fermentation process as well as the processing and refinement of the final product.

After successful completion of the subject **Biofuels and Products from Renewable Resources**, the graduate

- can state the basic aspects of chemical and biochemical processes of transformation of renewable resources (biomass, waste from agricultural or food production, municipal waste),
- can describe methods for the complex use of renewable resources with a focus on the production of energy, biofuels and a wide range of high value-added products (chemicals, polymers, etc.) within the biorefinery concept, with an emphasis on an overview of new processes using catalytic and biological systems and an overview of the wide range of products so produced.

After successful completion of the course **Fundamentals of Bioengineering** the student

- gains knowledge of basic bioengineering operations and bioreactor systems and integrates the knowledge gained so far into new contexts and extends the technological and engineering approach
- the student's competences will be applicable in production processes with a biotechnological focus

By completing the subject of ***in vitro* Plant Systems**, the graduate

- will gain knowledge and overview of different systems of plant cultivation under *in vitro* conditions and their applications,
- will know the nature of the processes occurring under *in vitro* conditions (totipotency, dedifferentiation, differentiation, morphogenesis, regeneration, somaclonal variation, etc.) and
- will understand the principles of establishing *in vitro* cultures from the collection of explants, through *in vitro* cultivation of various plant cells, tissues and organs, as well as whole plants, to obtaining regenerated plants,
- will gain knowledge about the current possibilities of using *in vitro* culture systems for the cultivation of plants and their parts, as well as about prospective applications in agriculture, but also in other branches of industry, pharmacy, medicine, energy,
- will be able to plan his/her own experiments and production procedures based on the principle of *in vitro* plant cultures,
- will understand and be able to design and implement the cultivation of plants in different in vitro systems,
- will be able to apply theoretical knowledge to laboratory activities or production practice (e.g. mass production of plants using *in vitro*, production of virus-free plants, production of haploid and dihaploid plants, etc.),
- will be competent to communicate with the professional public and to comment on both theoretical and practical aspects of *in vitro* plant production systems.

Within the subject of **Novel and Functional Foods**, the graduate is able to

- apply the knowledge acquired in other subjects (Enzyme Biotechnology, Microbial Biotechnology, Industrial Biotechnology, Fundamentals of Bioengineering, etc.) and the skills acquired in the Laboratory Exercises in Enzymology, Laboratory Exercises in Microbiology and Laboratory Exercises in Industrial Biotechnology,
- independently and critically apply knowledge and skills in the field of primary food raw materials, food production, animal feed, food and nutritional supplements and nutraceuticals,
- critically consider the correct approach to the development of processes for the production of new, modified and nutritionally more valuable foods (functional foods, specialty foods, etc.).

By completing laboratory exercises in various areas of the life sciences, such as molecular biology, industrial biotechnology, or plant biotechnology, students will gain an overview of advanced methods used in laboratories, acquire advanced laboratory skills in working with living organisms or samples from living organisms, and learn how to manipulate laboratory instruments.

As part of the European Qualifications Framework, students will undertake **Laboratory Exercise in Advanced Molecular Biology Techniques** and acquire skills and competences such as following instructions and planning their own procedures for experimental work, specifically basic laboratory skills for working in a biotechnology laboratory, working with DNA, RNA, proteins, recombinant molecules, enzymes.

The graduate:

- acquire the ability to analyse data and present these data as a basis for important decisions in their future experimental practice,
- master all chemical calculations, unit conversions and acquire the skills that are a prerequisite for the successful implementation of the experimental part of the thesis,
- is able to use laboratory apparatus routinely and to acquire correct knowledge of the principles of laboratory practice,
- know how to use information databases and work with them in the context of relevant tasks,
- can design and carry out an experiment,
- is able to correctly evaluate the results obtained and discuss them with relevant practice and/or scientific databases,
- is able to draw conclusions and correct procedures in relation to a given topic,
- is competitive among peers with regard to the international arena,
- is prepared to engage in molecular biology research at a professional level.

The **Laboratory Exercise in Industrial Biotechnology** subject is a specialized subject. It aims to provide students with an overview and practical skills in basic biotechnology methodologies when working with biological/biotechnological objects at both the subcellular and cellular level. The graduate is:

- able to apply the acquired knowledge in the fermentative production of primary and secondary metabolites of microorganisms,
- able to identify the basic requirements of the fermentation process depending on the producer,
- familiar with the calculations necessary for the implementation of fermentation production,
- able to design the appropriate isolation and purification step depending on the type of metabolite to be obtained and
- able to evaluate data and present them in an appropriate form and is able to confront the results with scientific literature.

By completing the subject **Laboratory Exercise on *in vitro* Plant System**, the student gain

- working skills and habits in the collection and transfer of non-sterile plant explants to *in vitro* conditions,
- learn specific principles of working with plant explants,
- master the preparation of complex culture media, handling of plant hormones,
- master the methods of *in vitro* cultivation and
- skills in sub-culturing dedifferentiated and differentiated weeds and structures.

In specialized thesis courses such as **Laboratory Exercise for Diploma Thesis I, Laboratory Exercise for Diploma Thesis II** and **Laboratory Exercise for Diploma Thesis III**, the student

- develops and consolidates the habits of methodological discipline in the preparation of the thesis
- demonstrate knowledge and skills in literature search from primary and secondary sources
- demonstrate basic knowledge in the orientation of the problem addressed, as well as skills in writing scientific papers.

The result of individual subjects is a comprehensive dissertation within two years elaborated in the scope defined in the Higher Education Act of the Ministry of Education, Science, Research and Sport of the Slovak Republic. As a result of the education, the student acquires the ability to

- propose hypotheses,
- verify it with a suitably designed and constructed experiment or set of experiments
- evaluate the results and process them in the form of a thesis

The graduate can

- solve problems during the experimental activities within the diploma thesis
- design appropriate procedures for modifying an experiment
- work independently in the laboratory

- communicate with experts within the scope of his/her thesis topic; and
- present his/her results to experts.

Prepared by: RNDr. Daniela Ondrejovič Chmelová, PhD.

Date: 28.02.2022