List of subject information sheets for the Master's degree programme in Biotechnology

List of subject

Compulsory subjects:

1. **Biofuels and Renewable Products**
2. Diploma Thesis Seminar
3. **Fundamentals of Bioengineering**
4. Fundamentals of Genomics
5. ***in vitro* Plant Systems**
6. **Industrial Biotechnology**
7. Instrumental Methods for the Analysis of Substances
8. **Laboratory Exercise for Diploma Thesis I**
9. **Laboratory Exercise for Diploma Thesis II**
10. **Laboratory Exercise for Diploma Thesis III**
11. **Laboratory Exercise in Advanced Molecular Biology Techniques**
12. **Laboratory Exercise in Industrial Biotechnology**
13. **Laboratory Exercise on *in vitro* Plant Systems**
14. **Molecular Biology Techniques**
15. **Molecular Biotechnology**
16. Nanobiotechnology
17. **Novel and Functional Foods**
18. Pharmaceutical and Medical Biotechnology
19. Theory and Methodology of Diploma Thesis

*** The profile subjects are marked in bold**

Compulsory optional subjects:

1. Advanced Biochemistry
2. Bioanalytical Chemistry
3. Clinical Microbiology
4. Environmental Chemistry
5. Environmental Quality Assessment Methods
6. Exploitation and Conservation of Biological Resources
7. Forensic Chemistry
8. Imaging Techniques
9. Influences of Stress Factors on Biota
10. Introduction to Biophysics
11. Metal Recycling Biotechnology
12. Molecular Biology and Human Genetics
13. Mycology
14. Pharmaceutical Botany
15. Proteomics
16. Radioecology
17. Remediation Technology
18. Selected Chapters in Virology
19. Wastewater Treatment Technology

Optional subjects:

1. Sports Activities I
2. Sports Activities II
3. Sports Activities III
4. Sports Activities IV

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Compulsory courses

University of Ss. Cyril and Methodius in Trnava
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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md309	**Subject name: Biofuels and Renewable Products**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: The acquired knowledge of the students will be tested during the semester by 3 midterm tests and a final exam, and only students who achieve at least 50% of the points from the midterm tests will be admitted to the exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of the subject, the student is able to - state the basic aspects of chemical and biochemical processes of transformation of renewable resources (biomass, waste from agricultural or food production, municipal waste), - describe methods for the complex use of renewable resources with a focus on the production of energy, biofuels and a wide range of high added value products (chemicals, polymers, etc.) within the biorefinery concept, with emphasis on an overview of new processes using catalytic and biological systems and an overview of the wide range of products so produced.	
Brief content of the subject: 1.Renewable resources (biomass, waste from agricultural or food production, municipal waste, etc.) vs. oil as feedstock for industrial production, perspectives, risks. 2. Production of energy, biofuels and bioproducts. Principles of biorefinery. 3. Generation of biofuels (1st, 2nd, 3rd, 4th). 4. Sustainability of production processes, its assessment, principles of LCA method. 5. Principles of chemical transformations, thermochemical processes of biomass transformation, hydrolysis, pyrolysis, gasification, syngas production, processing of individual biomass components, catalytic processes of biofuel production and initial intermediates of industrial organic synthesis. 6. Biochemical processes (enzymatic transformations, hydrolysis, fermentations, use of microbial systems), biotransformation of lignocellulosic materials. 7. Bioprocesses for the production of biofuels (bioethanol, biomethane, DME, biodiesel, hydrogen) and chemicals in the biorefinery concept. 8. Biotransformation of alcohols, acids, carbohydrates, amino acids, esters and other low molecular weight substances, biotransformation of polymers. 9. Catalytic transformations of biomass fractionation intermediates and by-products of biofuel production. 10. Production of biodegradable plastics from biomass as feedstock. 11. Production of high value-added products including polymers. 12. Examples of industrial applications.	
Recommended literature: *P. Fornasiero and M. Graziani: Renewable Energy and Renewable Resources, Taylor Francis Ed. 2011.*	

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Haibo Xie: The Role of Green Chemistry in Biomass Processing and Conversion,SAGE, 2013.					
Language, knowledge of which is necessary to complete the subject: English					
Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. RNDr. Miroslav Ondrejovič, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md331	**Subject name: Diploma Thesis Seminar**
Type, scope, and method of educational activities: Compulsory subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of seminars per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 4	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: The prerequisite for successful completion of the subject is work during the semester on the thesis and partial assignments of the teacher. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: - An independent and creative approach to solving a selected experimental problem, - deepened knowledge and skills of the student in the analysis of the assigned problem, - ability to propose a solution to the problem and to process the results into a presentation form.	
Brief content of the subject: It follows from the assignment of the diploma thesis. Formal outline of the thesis: Introduction (outlining the current state of the problem to be solved). Objective of the thesis. Theoretical part. Experimental part. Results and discussion. Conclusions. Literature. Processing of tasks on selected topics in the field of biotechnology.	
Recommended literature: *According to the diploma thesis. Original and review articles from recent literature and internet sources. Literature related to the subject of Biotechnology (Industrial Biotechnology, Pharmaceutical and Medical Biotechnology, Nanobiotechnology, Molecular Biotechnology).*	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Teacher: RNDr. Daniela Ondrejovič Chmelová, PhD.
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md325	**Subject name: Fundamentals of Bioengineering**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Attendance at the lectures. Successful completion of the final (oral) exam. During the semester, the student takes 1 preliminary test. To take the final exam, the student must obtain at least 51% of points from the preliminary test. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of the course - student gains knowledge of basic bioengineering operations and bioreactor systems - knowledge gained so far will be integrated into new contexts and extended to the technological and engineering approach student's competence will be usable in production processes with a biotechnological focus.	
Brief content of the subject: 1. History of bioengineering: biochemical and biomedical engineering 2. bioreactors - division, construction, "scale up processing" 3. Batch bioreactors, fed batch and continuous bioreactors 4. Preparatory biotechnological operations - sterilization of liquid medium, sterilization of equipment, filtration and sterilization of gases 5. Implementation and specifics of mixing in the bioreactor 6. Bioreactors without forced air circulation and with forced air circulation 7. Bioreactors with immobilized enzymes, fixed bed bioreactors, fluidized bed bioreactors, 8. Photobioreactors, membrane bioreactors, biofilm bioreactors, tray bioreactors 9. Aeration and methods of oxygen distribution, kLa in bioreactors 10. Measured and controlled variables during cultivation in the bioreactor 11. "Upstream" processes - storage of microorganisms, growth curve, culture medium, diauxia, growth inhibition by substrate 12. "Downstream" processes - product types, product isolation, product polishing, product packaging.	
Recommended literature: *Kaštánek F. Bioinženýrství, Academia Praha, 2001, ISBN 80-200-0768-7*	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

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Teacher: Assoc. Prof. Ing. Jana Moravčíková, PhD.
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md304	**Subject name: Fundamentals of Genomics**
Type, scope, and method of educational activities: Compulsory subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Elaboration of a semestral work on a chosen topic in the field of genomics, presentation of the work and passing an oral or written exam. The credits will not be awarded to the student who does not prepare and present a semestral work and together does not obtain more than 55 % of the exam points. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The student will gain knowledges: - about processing and comparison of complete sequence data of prokaryotic and eukaryotic genomes, - about identification and localization of the genes in the genomes, - about gene expression profiles, about genome structures, - about evolution of genomes, genes and their regulatory regions, comparison of genes and genomes and their evolutionary relationship, - about basic genomic databases, - about the latest methodological trends in genomics, - about the use of genomics in medicine.	
Brief content of the subject: 1. Introduction to genomics – definition of basic terms, Genome projects 2. Structural genomics, Transcriptomics, gene expression regulation, system biology, molecular interactions 3. Comparative genomics – genomic taxonomy, model genomic organisms 4. Genomics of prokaryotes, structure, and extent of genomes 5. Genomics of eukaryotes, structure and extent of genomes, Chromosomes 6. Evolutionary genomics and biological processes of domestication of organisms 7. Genomic technologies – direct sequencing, massive parallel sequencing (2nd generation sequencing) 8. Genomic technologies – microarray hybridization genomic analyzes, expression profiles 9. Genomic databases – DNA, RNA, protein databases, types of reference sequences, bibliographic databases 10. Basics of genomic bioinformatics and prediction – sequence alignment procedures (local, multiple), Dot plot graphs, matrices, BLAST, phylogenetic trees	

11. Evolutionary genomics and characteristics of ancient DNA
12. Introduction to genomic medicine, principles of genetic counselling

Recommended literature:

Bauerová a kol.: Metódy analýzy génov a genómov. FPV UKF, 197s., 2008, ISBN 978-80-8094-408-7
Drahovská a kol.: Genomika a bioinformatika. VEDA vydavateľstvo SAV, 2007, ISBN 978-80-224-0995-7
J. F. Griffiths a kol.: Introduction to Genetic Analysis, W. H. Freeman and Company, 2015
Arthur M Lesk, A.M.: Introduction to Genomics. Oxford University Press, 2012.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Prof. RNDr. Juraj Krajčovič, CSc., RNDr. Michal Konečný, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md327	**Subject name: *in vitro* Plant Systems**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Successful completion of the oral exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The student: - will gain knowledge and overview of various plant *in vitro* cultivation systems and their applications - will know the essence of *in vitro* processes (totipotency, dedifferentiation, differentiation, morphogenesis, regeneration, somaclonal variability, etc.) - 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, but also whole plants, to obtaining regenerated plants - gain knowledge about the current possibilities of using *in vitro* plant cultivation systems and their parts, but also about promising applications in agriculture, but also other industries, pharmacy, medicine, energy. By completing this course and using the knowledge acquired in other related courses - will be able to plan their own experiments and production processes on the principle of *in vitro* plant cultures - will understand and be able to design and ensure the cultivation of plants in various *in vitro* systems - will be able to find out theoretical knowledge in the laboratory and production practice (e.g. mass production of plants by *in vitro*, production of virus-free plants, production of haploid and dihaploid plants, etc.) will be competent to communicate with the professional community and discuss about theoretical and practical aspects of *in vitro* plant production systems.	
Brief content of the subject: 1. Introduction to *in vitro* plant cultures - *in vitro* plant tissue cultures, totipotency, plant explants 2. Laboratory of explant cultures, *in vitro* culture conditions, culture media, growth regulators 3. *In vitro* morphogenesis - dedifferentiation, redifferentiation, regeneration, somatic embryogenesis, organogenesis 4. Micropropagation of plants *in vitro* - meristem cultures, micropropagation, plant healing *in vitro* 5. Callus cultures, cell suspension cultures 6. Production of biomass and secondary metabolites 7. Protoplast cultures, somatic hybridization 8. Embryocultures, interspecific and intergeneric hybridizations	

9. Production of haploids and dihaploids - pollen and anther cultures, ovocultures
10. *In vitro* selection and somaclonal variation
11. Methods of transgenic plants I - vector-mediated plant transformations, *A. tumefaciens* system
12. Methods of transgenic plants II - direct methods of gene transfer, transformation of plants by biolistic method

Recommended literature:

Kraic J. a kol.: Biotechnológie rastlín. UKF v Nitre, 2011, s. 320, ISBN 9788080948856
Bhojwani, S.S., Dantu, P.K.: Plant Tissue Culture: An Introductory Text. Springer India, 2013, pp. 318, ISBN 978-81-322-1026-9 (eBook)
Loyola-Vargas, V.M., Ochoa-Alejo, N.: Plant Cell Culture Protocols. Humana Press, 2018, pp. 504, ISBN 978-1-4939-8594-4 (eBook)
Nick, P., Opatrný, Z.: Applied Plant Cell Biology. Cellular Tools and Approaches for Plant Biotechnology. Springer-Verlag Berlin Heidelberg, 2014, pp. 485, ISBN 978-3-642-41787-0 (eBook)
Pavlov, A., Bley, T.: Bioprocessing of Plant In Vitro Systems. Springer International Publishing AG, 2018, pp. 591, ISBN 978-3-319-54601-8

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Prof. RNDr. Ján Kraic, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md327	**Subject name: Industrial Biotechnology**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Students' acquired knowledge will be tested during the semester by three midterm tests and a final exam, and only students who score at least 50% on the midterm tests will be admitted to the exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of the course, the student will be able to: - describe the basic steps in the biotechnological production of selected industrial products, the raw materials used for a given production, the organism or enzyme used in a given stage of production, as well as the actual applicability of the target products - explain the principles of the methods used in the processing of feedstock, in the control of the fermentation process, as well as in the processing and refinement of the final product.	
Brief content of the subject: 1. The position of the subject in the study programme, in the system of sciences, in practice, in personal and social life. 2. History of industrial biotechnology, present and future perspectives. 3. Industrial biotechnological systems. Microorganisms, explants of plant objects, animal models. Acquisition, breeding and optimisation of production parameters 4. Industrial biotechnological equipment and processes. Bioreactor types and processes. Downstream and upstream facilities and processes. 5. Overview and basic characteristics of food and chemical biotechnology products. 6. Specialised industrial production - beer and wine production. 7. Specialised industrial production - production of distillates and yeasts. 8. Specialized industrial production - production of acids, dyes, biopolymers. 9. Industrial biocatalysts. Other biocatalytic systems. Enzymes and catalysts derived therefrom. 10. Microbial and other cellular transformations of alcohols, acids, carbohydrates, amino acids, alkanes, aromatics, heterocycles, esters, amides and other low-, medium- and high-molecular-weight compounds. Practical applications in the food and chemical industries. 11. Enzyme, protein and gene engineering. 12. Biorecycling of wastes from industrial activities.	
Recommended literature: *Soetaert W., Vandamme E. J.: Industrial biotechnology, Wiley, Weinheim, 2010, 499 p.* *Flickinger M. C. et al.: Encyclopedia of industrial biotechnology, Wilex, New York, 2010, 4887 p.*	
Language, knowledge of which is necessary to complete the subject: English	
Subject evaluation	

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A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. RNDr. Miroslav Ondrejovič, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KCH/md303	**Subject name: Instrumental Methods for the Analysis of Substances**
Type, scope, and method of educational activities: Compulsory subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Participation in lectures and seminars. There will be two written examinations during the semester, each worth 20 points. A minimum of 12 points for each. A total of a minimum of 24 points is required for the examination and one seminar paper in the lecture area. An exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon completion of the subject, students - acquire theoretical and practical knowledge of modern instrumental methods that they will be able to use in practice in industry, medicine, food and environmental control, etc. - they will be able to select the appropriate analytical method according to their needs - know its advantages and disadvantages of instrumental methods - be able to apply it and interpret the data obtained.	
Brief content of the subject: 1. Instrumental methods, division and meaning. Division of separation methods. Extraction methods, SPE. 2. Chromatographic methods, division. Basic and elution characteristics. Evaluation of chromatographic records. 3. Liquid chromatography, partition adsorption, principle, instrumentation. Extremely efficient liquid chromatography. Application of methods in practice. Other types of LC. Capillary gas chromatography, extended theory. 4. Recent trends and selected applications. 5. Electromigration methods, theory, use of electrophoretic methods in the analysis of biomolecules. 6. Mass spectrometry, coupled techniques, GC/MS, LC/MS, CE/MS. On-chip separations. Interactions of electrons and electromagnetic radiation. Instrumentation in optical methods. 7. Use of atomic spectra, AAS, flame AES, ICP, atomic fluorescence spectroscopy. X-ray analysis. 8. Molecular spectrometry UV/VIS, in IC region, luminescence analysis, Raman spectrometry. 9. Nuclear magnetic resonance. Theoretical basis of electroanalytical methods, signal of electroanalytical measurement. 10. Potentiometry, electrode potential, use of ion selective electrodes, potentiometric titrations. 11. Polarography - principle, newer polarographic methods and their applications. 12.Voltammetric titrations. Coulometry, principle, coulometric titrations. Conductometry and conductometric titrations.	
Recommended literature:	

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V.R. Meyer, Wiley, 2010, ISBN: 978-0-470-68218-0, Chromatography (6th edition), Fundamentals and Applications of Chromatography and Related Differential Migration Methods.
E. Heftmann, Part A, Elsevier, 2004, ISBN: 0-444-51107-5.
Watson J. T., Sparkman O. D.: Introduction to Mass Spectrometry. Wiley, Chichester, GB, 2007, ISBN 978-0-470-51634-8.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Assoc. Prof. Ing. Andrea Purdešová, PhD.; Ing. Mária Maliarová, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md310	**Subject name: Laboratory Exercise for Diploma Thesis I**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours): 10** hours of laboratory exercises per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 10	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students' independent work on the literature search for the diploma thesis will be evaluated as a prerequisite for passing the exam. At the end of the semester, the final thesis will be evaluated, the level of use of relevant literature sources, their processing and use, the level of elaboration and the final presentation of the thesis. The evaluation will be conducted before a committee composed of members of the department. The literature search will contain a minimum of 45,000 characters with spaces and the experimental thesis a minimum of 17,000 characters with spaces and 50 relevant citations. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Students in the subject - demonstrate knowledge and skills in literature searching from primary and secondary sources - demonstrate basic knowledge in the orientation of the problem addressed as well as skills in writing scientific papers - as a result of the training, the student will acquire the ability to propose a hypothesis, verify it with an appropriately set up and designed experiment or set of experiments, evaluate the results and process them into a thesis - the student will be able to solve problems during the experimental activity within the thesis and to propose appropriate procedures for modifying the experiment - is able to work independently in the laboratory, to communicate with experts within the scope of his/her thesis topic and to present his/her results to experts.	
Brief content of the subject: Introduction to the topic according to the type of project. Literature search in relevant databases on the Internet, processing of literature references, defining the objectives and planning of the project, selection of methods. Elaboration and presentation of the project.	
Recommended literature: *Review of books, journals and other literature according to the project topic.*	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

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Námestie Jozefa Herdu 2
917 01 Trnava

Teacher: diploma thesis supervisors
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.

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

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md330	**Subject name: Laboratory Exercise for Diploma Thesis II**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 15 hours of laboratory exercises per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 10	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students' independent work on the literature search for the thesis will be evaluated as a prerequisite for passing the exam. At the end of the semester, the final thesis will be evaluated, the level of use of relevant literature sources, their processing and use, the level of elaboration and the final presentation of the thesis. The evaluation will be conducted before a committee composed of members of the department. The literature search will contain a minimum of 45,000 characters with spaces and the experimental thesis a minimum of 25,000 characters with spaces and 65 relevant citations. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Students in the subject - demonstrate knowledge and skills in literature searching from primary and secondary sources - demonstrate basic knowledge of the subject matter addressed as well as skills in writing scientific papers - as a learning outcome, the student will acquire the ability to propose a hypothesis, test it with an appropriately set up and designed experiment or set of experiments, and evaluate the results and elaborate them into a thesis - is able to solve problems during the experimental activities within the thesis and to propose appropriate procedures for modifying the experiment. is able to work independently in the laboratory, to communicate with experts within the scope of the thesis topic and to present his/her results to experts.	
Brief content of the subject: Introduction to the topic according to the type of project. Literature search in relevant databases on the Internet, processing of literature references, defining the objectives and planning of the project, selection of methods. Elaboration and presentation of the project.	
Recommended literature: *Review of books, journals and other literature according to the project topic.*	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Teacher: Diploma thesis supervisors
Date of last change: 28.02.2022

University of Ss. Cyril and Methodius in Trnava
Námestie Jozefa Herdu 2
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Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md332	**Subject name: Laboratory Exercise for Diploma Thesis III**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 23 hours of laboratory exercises per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 12	
Recommended semester/trimester of study: semester 4	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students' independent work on the literature search for the thesis will be evaluated as a prerequisite for passing the exam. At the end of the semester, the thesis, the level of use of relevant literature sources, their treatment and use, and the level of elaboration will be evaluated. The literature search will contain a minimum of 45,000 characters with spaces and the experimental thesis will contain a minimum of 45,000 characters with spaces and 75 relevant citations. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Students in the course - demonstrate knowledge and skills in literature searching from primary and secondary sources - demonstrate basic knowledge of the subject matter addressed as well as skills in writing scientific papers - the result of the individual LC courses for the diploma thesis is a comprehensively, within two years, the diploma thesis - the result of education is competence, i.e. the student acquires the ability to propose a hypothesis, to verify it with a suitably set up and designed experiment or set of experiments, and to evaluate the results and process them into the form of a diploma thesis - is also able to solve problems during the experimental activities of the thesis and to design appropriate procedures to modify the experiment - is able to work independently in the laboratory, to communicate with experts within the scope of the thesis topic and to present his/her results to experts.	
Brief content of the subject: Introduction to the topic according to the type of project. Literature search in relevant databases on the Internet, processing of literature references, defining the objectives and planning of the project, selection of methods. Elaboration and presentation of the project.	
Recommended literature: *Review of books, journals and other literature according to the project topic.*	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md302	**Subject name: Laboratory Exercise in Advanced Molecular Biology Techniques**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 6 hours of laboratory exercises per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 5	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: An essential condition for completing the course is active participation in all laboratory exercises. Each exercise includes a written examination before the exercise, the condition for passing the exercise is a minimum grade E. The evaluation of the exercise is a summary of the classification of theoretical readiness and practical skills, student knowledge, which declares the degree of independence of the exercise and the subject is to develop your own protocol for each exercise. The final evaluation is a summary of the evaluation of individual exercises, the student's approach, i. degree of its independence, elaboration of protocols from individual exercises and elaboration of a final test for the minimum grade E. Credits will not be awarded to a student who does not achieve a score corresponding to grade E. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Within the European Qualifications Framework, students acquire the following skills and abilities by completing the subject: - follow instructions and plan their own procedure in experimental work, namely - basic laboratory skills for working in a biotechnology laboratory, working with DNA, RNA, protein, recombinant molecules, enzymes - students gain the ability to analyze data and present this data as a basis for important decisions in their further experimental practice - successful graduate masters all chemical calculations, unit conversions and acquires skills that are a prerequisite for successful implementation of the experimental part of the thesis - the graduate is able to routinely use laboratory tools and correctly masters the principles of laboratory practice - can use information databases and work with them within the relevant tasks - knows how to design and carry out an experiment - can correctly evaluate the achieved results and discuss them with relevant practice, resp. scientific databases - can draw conclusions and correct procedures with respect to the assigned topic - the graduate is competitive within peers with respect to the international space - the graduate is ready to participate in the work process in the field of molecular - biological research at a professional level.	
Brief content of the subject: 1. Immunochemical detection of proteins by western blotting methodology is a part of the studied problem 2. Media preparation, inoculation of bacterial strains	

3. Isolation of plasmid DNA using commercially available kits,
4. Restriction analysis of plasmid DNAs
5. Agarose gel electrophoresis, DNA digestion using restriction endonucleases
6. Comparison of real digest with in silico analysis
7. Isolation of DNA fragment from agarose gel, design
8. Conversion and preparation of the ligation mixture composition
9. Isolation of RNA from animal tissues
10. integrity check of isolated RNA, integrity evaluation, concentration measurement
11. Preparation of cDNA. Application of polymerase chain reaction on cDNA - reverse transcriptase PCR templates
12. Starch zymography, biochemical analysis of selected enzyme

Recommended literature:

Sambrook, J., Russel, D. W.: The Condesed Protocols from Molecular Cloning: A laboratory Manual, Cold Spring harbor Labortatory Press, 2006

Laboratory practice in molecular biology and biotechnologies [electronic] / Daniel Mihálik, Miroslav Glasa; recenzenti Ľubica Uváčková, Martina Hudcovicová. - 1. vyd. - Trnava: Fakulta prírodných vied, 2021. - 124 s.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Assoc. Prof. Mgr. Daniel Mihálik, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md307	**Subject name: Laboratory Exercise in Industrial Biotechnology**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 6 hours of laboratory exercises per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 5	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	

Conditions for completing the subject:

Completion of all laboratory exercises. At the beginning of the laboratory exercises, the teacher will test the knowledge of the students in the form of a test from the selected part of the laboratory exercises that they will complete in the given lesson. The student must score a minimum of 50 % on the laboratory exercises (examples, tests, protocols) in order to register for the examination and pass the course. The student must score at least 50 % on the exam in order to receive a final grade, which is the sum of the points earned on the lab exercises and the exam. The student will prepare a protocol in the form of a seminar paper and after completing units focused on the production, isolation, and utilization of both primary and secondary metabolites.

Overall evaluation of the course:

A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>;
B - very good (above the average standard but with some errors) = 1.5 <83-91 %>;
C - good (generally sound work with a number of notable errors) = 2 <74-82 %>;
D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>;
E - sufficient (performance meets the minimum criteria) =3 <56-64 %>;
FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>

Educational outcomes:

The subject "Laboratory Exercise in Industrial Biotechnology" is a specialized course, the aim of which is to

- provide students with an overview and practical skills in basic biotechnology methodologies when working with biological/biotechnological objects at 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
- the student is able to identify the basic requirements of the fermentation process depending on the producer
- the student is familiar with the calculations necessary for the implementation of fermentation production, as well as the design of an appropriate isolation and purification step depending on the type of metabolite obtained
- the graduate is able to evaluate data and present them in an appropriate form, being able to confront his/her results with the literature.

Brief content of the subject:

1. Lactic acid production I (Selection of the producing organism)
2. Lactic acid production II (Fermentation production of lactic acid)
3. Lactic acid production III (Isolation and purification of lactic acid)
4. Sucrase production and characterisation (Influence of selected fermentation parameters on sucrase production by selected yeast species)
5. Sucrase production and characterization (Isolation and purification of sucrase from cell biomass)
6. Sucrase production and characterization (Biochemical characterization of sucrase)
7. Production of antibiotics (Selection of production organism, fermentative production of antibiotics)
8. Antibiotic production (Isolation of antibiotics from culture medium)

9. Antibiotic production (Determination of minimum inhibitory concentration)
10. Citric acid production (Production of citric acid by filamentous fungi).
11. Citric acid production (Isolation of citric acid from culture medium and its partial purification).
12. Production of bioethanol by yeast.

Recommended literature:
Material provided by the teacher.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: RNDr. Barbora Legerská, PhD., RNDr. Daniela Ondrejovič Chmelová, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md328	**Subject name: Laboratory Exercise on *in vitro P*lant Systems**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 5 hours of laboratory exercises per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 5	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Regular participation in laboratory exercises, submission of all laboratory protocols. During the semester, the student must obtain at least 51% of points from preliminary tests and at least 51% of points for laboratory protocols. The final exam will be in a written form. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Learning outcomes will be acquisition of practical skills, based on the knowledge gained from the subject "*In vitro* Plant Systems" The student - acquires work skills and habits for the collection and transfer of non-sterile plant explants to in vitro conditions - learns specific principles of working with plant explants - masters the preparation of complex culture media, handling plant hormones - masters *in vitro* cultivation methods and skills for subculturing dedifferentiated and differentiated tissues and structures.	
Brief content of the subject: 1. Principles of work with plant material in *in vitro* conditions; preparation of culture media and the methods of their sterilization; phytohormones - preparation of stock solutions and the methods of their sterilization and the long-term storage. 2. Transfer of plant material (seeds) from *in vivo* to *in vitro* conditions, selection of the correct sterilization procedure 3. Transfer of plant material (vegetative tissues) from *in vivo* to *in vitro* conditions, selection of the correct sterilization procedure 4. Induction of plant cell regeneration from different types of explants in *in vitro* conditions using different combinations of plant hormones, direct organogenesis and indirect organogenesis 5. Recalcitrance in *in vitro* culture and possibilities of elimination. 6. Isolation and regeneration of immature zygotic embryos in *in vitro* conditions 7. *In vitro* plant material multiplication; transfer from *in vitro* to *in vivo* conditions; transfer from *in vitro* to hydroponics 8. Transformation and regeneration of plants using *A. tumefaciens* 9. Isolation of pollen and determination of pollen viability 10. Suspension cultures 11. Isolation of protoplasts 12. Effect of *in vitro* culture conditions on the content of photosynthetic pigments in plant tissue	

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Recommended literature:

Gálová, Z, Balážová, Ž, Michalík, I, Libantová, J, Moravčíková, J, Hricová, A., Matušíková, I. Biotechnológie v rastlinnej produkcii. Prvé prepracované vydanie. Nitra: Slovenská poľnohospodárska univerzita, December 2008. 149s. ISBN 978-80-552-0146-7.

Kraic, J, Faragó, J, Ostrolucká, MG, Libantová, J, Moravčíková, J, Jomová, K., Hraška, Š. Biotechnológie rastlín. FPV UKF v Nitre, 2011. 320 s. ISBN 978-80-8094-885-6.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Assoc. Prof. Ing. Jana Moravčíková, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md300	**Subject name: Molecular Biology Techniques**
Type, scope, and method of educational activities: Compulsory subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Successful completion of the oral exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The student: - will gain knowledge and overview of selected areas of molecular biology, especially the basic methods of DNA analysis - will know the basic techniques of analysis and characterization of nucleic acid molecules (fragments) After completing this course, and using the knowledge gained in other related courses, it will: - be able to design and implement molecular-biological analysis of nucleic acids, especially DNA, for example in the construction of recombinant DNA and the production of recombinant proteins - gain knowledge of the nature, principles, and methods of implementation of selected, the most important techniques of molecular biotechnology used particularly in DNA and RNA experiments, mainly DNA hybridization and amplification techniques, DNA sequencing techniques (1st to 3rd generation), quantitative DNA analysis, DNA expression analysis, DNA microarrays - gain knowledge about 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 - understand the principles of these techniques, thus gaining the ability to absorb future modified and new and emerging techniques and procedures of molecular biotechnology - be able to choose techniques and procedures for the implementation of biotechnological experiments that will use professionally (in laboratory or production practice) - be able to design and plan own procedures and techniques for DNA polymorphism analysis - be competent to independently determine suitable procedures and techniques for molecular biotechnology - be competent to communicate with the professional community, to comment theoretical and practical aspects of the application of molecular biological techniques.	
Brief content of the subject: 1. Highly variable regions of genomic DNA - repetitive sequences, dispersed sequences, satellite DNA, microsatellites 2. Mechanisms of variation and correction mechanisms in DNA (mutations and correction mechanisms) 3. Hybridization techniques of DNA analysis	

4. DNA amplification analyzes
5. Sequencing techniques of DNA analysis
6. Sequencing techniques of 2nd and 3rd generation DNA analysis
7. SNP and DNA microchip technologies
8. Methods of DNA quantification (qRT-PCR) and gene expression analysis (RT-PCR)
9. Genetic and cytogenetic
10. Methods of DNA (gene) editing
11. DNA polymorphism used in forensic DNA analysis in criminology (biological, technological, genetic part, line markers), DNA in historical studies
12. DNA polymorphism in the analysis of environmental samples (molecular ecology)

Recommended literature:

Šmarda, J. a kol.: Metody molekulární biologie. Masarykova univerzita, 2010, 188 s., ISBN 9788021038417

Šmehilová, M. a kol.: Laboratorní cvičení z molekulární biologie. Univerzita Palackého v Olomouci, 2014, 54 s., ISBN 978802444978802

Beránek, M.: Molekulární genetika pro bioanalytiky, 2016, Univerzita Karlova v Praze, 196 s., ISBN 978-80-246-3224-7

Ream, W.R., Field, K.G.: Molecular Biology Techniques: An Intensive Laboratory Course, 1998, Academic Press, pp. 248, ISBN 978-0125839907

Graham, C.A. et al.: DNA Sequencing Protocols, 2001, pp. 244, ISBN 978-0-89603-716-8

Adams, M.D. et al.: Automated DNA Sequencing and Analysis, Elsevier Science Publishing Co. Inc., 1994, pp. 368, ISBN 0127170103

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Prof. RNDr. Ján Kraic, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md301	**Subject name: Molecular Biotechnology**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Successful completion of the oral exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The student: - acquire knowledge about the nature, principles, and methods of preparation of recombinant DNA molecules, the production of recombinant proteins, methods of use and applications of techniques for the development of recombinant DNA molecules and recombinant proteins - will understand the principles of preparation of recombinant DNA molecules and production of recombinant proteins in various prokaryotic and eukaryotic host systems in vitro and in vivo - gain knowledge of current and future applications of these techniques and obtained products in various types of industries, pharmacy and medicine, agriculture, food and energy production After completing this course, using the knowledge gained in other related courses - the graduate will be able to design and implement biotechnological experiments and procedures for the preparation of recombinant DNA molecules and subsequent production of recombinant proteins - the student will be able to apply theoretical knowledge to laboratory activities and manufacturing practice - the student will be able to design and plan their own procedures for the production of recombinant organisms (prokaryotic and eukaryotic), methods and procedures for their cultivation and production of the desired recombinant proteins, respectively. RNA and DNA. The student will - able to independently determine the steps of working procedures leading to the final production of recombinant nucleic acids and proteins - will be competent to communicate with the professional community and also to comment theoretical and practical aspects of the production of recombinant organisms and recombinant proteins.	
Brief content of the subject: 1. Basics of recombinant DNA molecule technology - Molecular biotechnology - development, basic principles 2. Production of recombinant proteins - production in prokaryotic hosts, integration of the cloned gene into the chromosomal DNA of prokaryotes, industrial production of recombinant proteins 3. Production of recombinant proteins - production in eukaryotic hosts, integration of the cloned gene into the chromosomal DNA of prokaryotes, industrial production of recombinant proteins	

4. Recombinant proteins for protein therapy - therapeutic recombinant proteins (drugs, substitutes, lactic acid bacteria, antibodies)
5. Recombinant therapeutic DNA - recombinant nucleic acids as therapeutic molecules (antisense RNA, aptamers, ribozymes and DNAzymes, interfering RNA)
6. Recombinant subunit and peptide vaccines, DNA vaccines, recombinant attenuated vaccines
7. Production of recombinant proteins in plants - technique of transfer of recombinant DNA into plants (nuclei, chloroplasts), temporary expression
8. Plants as objects of recombinant DNA techniques - resistance to pests, viruses, fungi and bacteria, tolerance to herbicides,
9. Plants as objects of modified DNA techniques - resistance to salt and drought, modification of content, taste, and appearance of plant products, production capacity, plants as bioreactors, production of edible vaccines
10. Applications of recombinant DNA techniques in animals - objects of recombinant DNA techniques, recombinant DNA and vectors for microinjection, retroviral vectors, embryonic cells, knock-down - reduction of gene expression
11. Industrial and environmental applications of recombinant DNA - production of restriction endonucleases, vitamins, amino acids, pigments, antibiotics, biopolymers, degradation of xenobiotics, use of starch and sugars, use of lignocellulose, production of hydrogen
12. Recombinant DNA technologies and society - rules for GMOs, food and GMOs, social and religious aspects of GMOs, perception of GMOs

Recommended literature:

Valková a kol.: Úvod do molekulárnej biotechnológie. VEDA Vydavateľstvo SAV, 2005, 167 s., ISBN 80-224-0845-X

Turňa a kol.: Techniky rekombinatných DNA. VEDA Vydavateľstvo SAV, 2004, 152 s., ISBN 80-224-0835-2

Glick, B.R., Patten, C.L.: Molecular Biotechnology: Principles and Applications of Recombinant DNA, 5th ed., 2018, T&F India, pp. 740, ISBN 9781683670360

Khan, M.S. et al.: Applied Molecular Biotechnology. The Next Generation of Genetic Engineering. CRC Press, 2016, pp. 622, ISBN 978-1-4987-1483-9

Kraic, J. et al.: Progress in the genetic engineering of cereals to produce essential polyunsaturated fatty acids. Journal of Biotechnology, 2018, 284, 115–122. DOI:10.1016/j.jbiotec.2018.08.009

Mihálik, D. et al.: Diacylglycerol acetyltransferase gene isolated from Euonymus europaeus L. altered lipid metabolism in transgenic plant towards the production of acetylated triacylglycerols. Life, 2020, 10, 205. DOI:10.3390/life10090205

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Prof. RNDr. Ján Kraic, PhD.

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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md326	**Subject name: Nanobiotechnology**
Type, scope, and method of educational activities: Compulsory subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 5	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Attendance at the lectures. Successful completion of the final (oral) exam. During the semester, the student takes 1 preliminary test. To take the final exam, the student must obtain at least 51% of points from the preliminary test. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of the course, the student - acquires knowledge in the field of nanobiotechnology, which has received a great deal of attention in recent years, not only in terms of their application in food, agriculture, medicine or improving the quality of the environment, but also in terms of their impact on human health and other organisms - will be able only to understand what nanomaterials are, what their potential is for the future, but also to be able to assess the risks associated with the use of such technology.	
Brief content of the subject: 1. History of nanotechnologies, nanotechnologies in the world and in Slovakia, economic benefits 2. Nanomaterials, distribution, their classification and basic methods of preparation, green synthesis 3. Nanotechnologies in food industry - food processing, types of nanomaterials and their use 4. Nanotechnologies in food industry - food packaging, types of nanomaterials and their use, smart packaging 5. Nanotechnologies in food industry - food safety, nanobiosensors, nanotracers 6. Nanobiotechnologies in agriculture - nanofertilizers, nanopesticides, precision management 7. Nanotoxicity and plant system 8. Nanotechnologies and biofuel production 9. Nanobiotechnology in medicine - disease detection, imaging methods, prevention and control, targeted drug delivery 10. Nanomaterials and their use in remediation, water purification, nanobionic plants 11. Nanomaterials in terms of health and environment and society, their positives and negatives 12. Labeling of nano ingredients in food products, regulatory status of food nanotechnologies in the EU	
Recommended literature: *Amparo López Rubio, Maria José Fabra Rovira, Marta Mrtínez Sanz, Laura Gómez Gómez-Mascaraque, In Micro and Nano Technologies, Nanomaterials for Food Applications, Elsevier,2019, ISBN 9780128141304.*	

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Kole, C., Kumar, D.S. and Khodakovskaya, M.V. eds., 2016. Plant nanotechnology: Principles and practices. Springer. ISBN 978-3-319-42152-0					
Language, knowledge of which is necessary to complete the subject: English					
Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. Ing. Jana Moravčíková, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md329	**Subject name: Novel and Functional Foods**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester will be done - as a form of continuous examination and a condition for the final exam - two tests (in the 7th and the 12th weeks of the semester). Each of the test will contain 10 questions for 10 points and the condition for successful completion is to obtain at least 50% from each test. The final exam will consist of a written part (3 questions) and subsequently from an oral examination. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The student is able to apply the knowledge obtained in other courses (Enzyme Biotechnology, Microbial Biotechnology, Industrial Biotechnology, Basics of Bioengineering and others) and skills obtained in Laboratory exercises in enzymology, microbiology, industrial biotechnology and others. The student is also able to independently and critically apply knowledge and skills in the field of primary food raw materials, food production, feed, food and nutritional supplements and nutraceuticals. He can also critically consider the right approach in the development of production processes of novel, modified, and more nutritionally valuable foods (functional foods, special foods, special diets and others).	
Brief content of the subject: 1. The concept of functional foods (definition, basic concepts, terms, classifications). 2. Food, beverages, food supplements, nutraceuticals, medicinal foods, fermented functional foods. 3. Current analysis of the functional food market based on the category of products, ingredients, countries. 4. The relationship consumer - functional foods, health, lifestyle, price. 5. Functional and nutraceutical food ingredients, probiotics and prebiotics, symbiotics, antioxidant stabilization of food. 6. Dietary fiber (inulin, beta-glucans and others), oligosaccharides, proteins and amino acids. 7. Modified fats and oils, fatty acids, phytosterols and stanols, antioxidants. 8. Mineral elements and pigments in food. 9. Development of foods with pharmacological components, health-enhancing foods (for the immunity, mental development, brain, obesity, diabetes, cardiovascular, and neurodegenerative diseases, osteoporosis, cancer and others). 10. Food allergies. Mediterranean diet foods and other diets. Functional foods for children. 11. Genetically modified foods. 12. Analytical methods for testing functional foods.	
Recommended literature: *Stein A.J., Rodrigues Cerezo E.: Functional Foods in the EU, JRC, Seville Spain, 2008. Gibson G.R., Williams Ch.M. et al.: Functional Foods. Woodhead Publishing Limited, Cambridge England, 2000.*	

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Wildman R.C. et al.: Handbook of Nutraceuticals and Functional Foods. CRC Press, Taylor and Francis Group, London England, 2007.
Bagchi D., Nair S. et al.: Developing New Functional Food and Nutraceutical Products. Academic Press of Elsevier, 2017.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Assoc. Prof. RNDr. Michaela Havrlentová, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md308	**Subject name: Pharmaceutical and Medical Biotechnology**
Type, scope, and method of educational activities: Compulsory subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Final test results. Participation on lectures in according with study rules, commitment of current work for each lesson. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The subject absolvent obtained the overlook about biotechnologies in the field of pharmacology and medicine, either in characterization of biotechnological products, probiotics and prebiotics, antibiotics, further about basic processes in the manufacture and application of biotechnological therapeutics, the significance of personalized medicine, perspectives of immunological aspects in diagnostic and therapy of serious diseases, about principles of genetic therapy, genetically modified organisms in production of biotechnologically active compounds, applied in prevention and therapy of diseases.	
Brief content of the subject: 1. Introduction, terminology, the importance of biotechnology in pharmacy and medicine. 2. Basic diseases categorization of human ad veterinary diseases in according with mechanism. 3. The characterization of biotechnological products in pharmacy and medicine. 4. Probiotics and prebiotics. 5. Antibiotics. 6. Genomic technologies and personalized medicine. 7. The characterization of biotechnological products 8. The production and processing of biotechnological therapeutics. 9. Immunology in diseases diagnostic and therapy. 10. Genetic therapy. 11. The application of genetically modified organisms in production of biologically active compounds I. 12. The application of genetically modified organisms in production of biologically active compounds II.	
Recommended literature: *KEEN, M. -- PONGRACZ, J. Medical Biotechnology. Edinburgh UK: Churrchill Livingstone Elsevier, 2009. 193 s. ISBN 978-0-08-045135-0.* *GROVES, M. Pharmaceutical Biotechnology. Boca Raton, Florida: CRC Press, Taylor &Francis Group, 2006. 411 s. ISBN 978-0-8493-1873-3.* *Khan F. A.: Biotechnology in Medical Science, CRC Press, 2014, 469 s., ISBN 978-1-4822–2367–5.* *Presented presentation in *.pptx format.*	

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Language, knowledge of which is necessary to complete the subject: English					
Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. Ing. Tibor Maliar, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md305	**Subject name: Theory and Methodology of Diploma Thesis**
Type, scope, and method of educational activities: Compulsory subject. Profile subject. **Subject type (C, CO, O):** C **Recommended scope of teaching (in hours): 8** hours of seminars per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 7	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Students' independent work on assignments will be evaluated throughout the semester as a prerequisite for passing the exam. At the end of the semester, the final thesis, the level of use of relevant literature sources, their processing and use, the level of elaboration and the final presentation of the thesis will be assessed. The evaluation will take place before a committee composed of members of the department. The thesis will consist of a minimum of 45,000 characters, including spaces, comprising a literature search and 30 relevant citations. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Students in the subject - demonstrate knowledge and skills in literature searches from primary and secondary sources - demonstrate basic knowledge of the subject as well as skills in writing scientific papers.	
Brief content of the subject: An introduction to the subject according to the type of project. Literature search in relevant databases on the Internet, processing of literature references, defining project objectives and planning, selection of methods. Preparation of experiments, evaluation of partial results, definition of conclusions. Elaboration and presentation of the project.	
Recommended literature: *Books, journals and other literature according to the project topic.*	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Teacher: Assoc. Prof. RNDr. Michaela Havrlentová, PhD., diploma thesis supervisors
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.

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Compulsory optional subjects

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md316	**Subject name: Advanced Biochemistry**
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Final test results. Participation on lectures in according with study rules. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The lesson Advanced biochemistry is one from the basic lessons of the study, because biochemistry as scientific discipline belongs to basic biological scientific disciplines in according with most focused attention to chosen particular biochemical aspects in close relation to lesson Biochemistry (General biochemistry). The lesson goal is to students - offer an overlook in the field of specialized and applied biochemistry - be able to apply received knowledges within other biological lessons.	
Brief content of the subject: 1. Static and dynamic biochemistry – brief repeating, selected aspects. 2. Basic aspects of drugs development. 3. Advanced biochemistry of oxidation stress and antioxidants. 4. Advanced biochemistry of infectious diseases and antibiotics. 5. Advanced biochemistry of oncological diseases and antineoplastics (oncolytics). 6. Advanced biochemistry of diseases with dysfunction of proteolytic enzymes and protease inhibitors. 7. Running test. 8. Advanced biochemistry of metabolic syndrome and DM of type I. and II. 9. Advanced biochemistry of immunity system disorders and related drugs. 10. Antibodies, monoclonal antibodies, recombinant antibodies and products. 11. Advanced biochemistry of diseases, associated with blood disorders and electrolytes. 12. Final test.	
Recommended literature: *Lubert Stryer, Jeremy Berg, John Tymoczko, Gregory Gatto (2019) Biochemistry, Macmillan Learning, 1208, ISBN: 1319114652.* *Presented presentation in *.pptx format.*	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

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Teacher: Assoc. Prof. Ing. Tibor Maliar, PhD.
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KCH/md339	**Subject name: Bioanalytic Chemistry**
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures and 1 hour of seminar per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: The participation on the lessons and seminars. During the semester are included two tests for 20 points, it is necessary to achieve minimally 12 points, together 24 points and seminar project work are requisitions to the exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: - The student will know after successful completing of the course following: - The most important methods of analysis of biochemical and biological samples in various application fields and as second the nature of the creation, processing and interpretation of analytical signal focused on utilization in biochemical and biological methods, using reagents and detection systems.	
Brief content of the subject: 1. Bioanalytical principles and sample processing. 2. Biological sample, sample processing before analysis, de-proteinisation of biological material, isolation of analytes from biological matrix, extraction methods, membrane techniques, isolation of analytes from tissues, isolation of informative molecules. 3. Instrumental analytical methods in analysis of biological samples, analytes derivatization, detection systems in chromatography. 4. Gas and liquid chromatography, bio-affinity chromatography. 5. Chiral separations. 6. Electro-migration methods. 7. Biochemical and biological analytical methods, enzyme analysis, catalytic cycles, immune-analysis and enzyme immune-analysis, PCR. 8. Detection methods of analytical signal from biochemical methods. 9. Utilization of cells and higher biological systems as detection systems. 10. Biosensors, principles, construction parts, detection methods of signal from biosensor. 11. Enzyme biosensors, immune-sensors, DNA, biosensors based on biological systems. 12. Biosensors application in environmental analysis, foods and food industry, further in monitoring of biotechnological processes, in clinical biochemistry and medicine.	
Recommended literature: *Viktor A Gault and Neville H. McClenanghan, Understanding Bioanalytical Chemistry, Wiley-Blackwell, 2009, ISBN: 9780470029077, 395 p.* *Presented presentation in *.pptx format.*	
Language, knowledge of which is necessary to complete the subject: English	

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Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. Ing. Andrea Purdešová, PhD., Ing. Mária Maliarová, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md311	**Subject name:** Clinical Microbiology
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures and 1 hour of seminar per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: 1.) participation in classes in accordance with the Study Regulations of the UCM in Trnava; 2.) preparation and presentation of a selected topic in the field of microbiology; 3.) active participation in seminars, discussion of presentations (to be taken into account in the overall assessment of the course); 4.) written test (30 questions); 5.) oral examination **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of the course, the student - will gain comprehensive knowledge and overview of the most important human microbial infectants, infections of human organ systems, the defence of the human organism against infectants through its immune system, as well as the application of antimicrobial agents, the pathogenic process in the macro-organism, and - will also become familiar with basic techniques and procedures of laboratory identification and diagnosis of pathogenic microorganisms.	
Brief content of the subject: 1. **Introduction to clinical microbiology.** Definition and subject of medical and clinical microbiology. Microorganisms as agents of infectious diseases. History and milestones of the science of infections. Important personalities of world and our microbiology. 2. **Bacterial infections.** General characteristics and classification of bacteria. Medically important Gram-negative bacteria. Medically important Gram-positive bacteria. Mycoplasmas. 3. **Viral infections.** General characteristics and classification of viruses. Epidemiology of viral infections. Pathogenesis of viral infections. Selected human viral infections. Prions. 4. **Mycotic infections.** General characteristics and classification of micromycetes. Epidemiology of mycotic infections. Agents of mycoses, parasitic fungi. Mycoses - superficial, subcutaneous, systemic. 5. **Protozoal infections.** General characteristics and classification of protozoa. Epidemiology of protozoal infections. Intestinal protozoal infections - amebiasis, coccidiosis, sporidiosis. Tissue and blood protozoal infections - trypanosomiasis, leishmaniasis, malaria, babesiosis, extraintestinal amebiasis. 6. **Pathogenicity and virulence of microorganisms.** Human physiological microbiota. Factors of pathogenicity and virulence - contagiosity, invasiveness, toxicity. Origin and course of microbial infections - pathogenic process.	

7. **Anti-infective immunity.** Natural resistance to infection - non-specific immunity. Acquired resistance to infection - specific immunity. Natural and artificial, active and passive immunization. Types of vaccines. Types of vaccination.
8. **Antimicrobial therapy.** Antimicrobial drugs - antibiotics, antifungals, antivirals, antiparasitics. Mechanism of action of antimicrobial drugs. Resistances to antimicrobial drugs. Adverse effects of antimicrobial drugs. Principles of rational antibiotic therapy.
9. **Decontamination.** Combating microorganisms. Survival of microorganisms in the environment. Devitalization, inactivation and elimination of microorganisms - sterilization and disinfection. Physical processes of sterilisation and disinfection. Chemical procedures for sterilisation and disinfection.
10. **Microbial aetiology of organ systems I.** CNS infections. Ocular infections. Ear infections. Oral infections. Respiratory tract infections. Intestinal infections. Urinary tract infections. Wound, soft tissue, bone and joint infections.
11. **Microbial aetiology of organ systems II.** Skin infections. Sexually transmitted infections. Fetal and neonatal infections. Nosocomial infections. Infections of immunocompromised patients. Septic conditions.
12. **Practical aspects of clinical microbiology.** Microbiology laboratory. Collection and transport of material for microbiological examination. Microscopic, culture, biochemical identification. Basic principles of laboratory diagnosis of viral, bacterial, mycotic and parasitic diseases. Rapid diagnostic methods and non-culture techniques in laboratory diagnosis of microbial diseases.

Recommended literature:

Murray, Rosenthal, Pfaller: ***Medical Microbiology,*** *Washington DC., ASM Press, 2015*
Jorgensen, Karen, Funke, Landry, Pfaller, Warnnock: ***Manual of Clinical Microbiology.*** *11. edition, Washington DC., ASM Press, 2019*

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Assoc. Prof. RNDr. Milan Seman, CSc.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KER/md332	**Subject name:** Environmental Chemistry
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: The following criteria will be assessed in the course (max. 100 points): 1. first continuous written test: max. 25 points 2. second continuous written test: max. 25 points 3. final oral examination: max. 50 points. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: After successful completion of the course, the student: - on the basis of the knowledge acquired from previous chemical disciplines, knows the basics of hydrochemistry, atmospheric chemistry and soil chemistry, knows the chemistry of natural and waste waters, respectively the chemistry of the troposphere.	
Brief content of the subject: 1. The role of environmental chemistry in the system of chemical sciences. 2. Physical and chemical properties of water. 3. Chemical reactions and chemical equilibria in waters. Gases in waters. 4. Acidity of waters and CO2 in waters. Alkalinity. pE values of natural waters. pE-pH diagrams. 5. Corrosion. 6. Phase interactions. Sediment formation. Colloidal properties of clays. 7. Sorption on the surface of solids. 8. Complexation and chelation. Complexation with humic substances. Relationship between complexation and redox processes. 9. Fundamentals of natural, applied and wastewater chemistry. Physical and chemical properties of the atmosphere. 10. Fundamentals of tropospheric and stratospheric chemistry. Photochemical reactions. 11. Chemistry of atmospheric particles. Chemistry of gaseous inorganic and organic air pollutants. 12. Fundamentals of geochemistry and soil chemistry. Acid-base and ion-exchange reactions in soils. Macro and micronutrients in soils. Wastes and pollutants in soils.	
Recommended literature: *S. E. Manahan: Environmental Chemistry. 6-th ed. CRC Press, Inc., Boca Raton, 1994. web link: http://www.chemistry.uoc.gr/courses/xhm405/01%20Environmental%20Chemistry%20 Manahan.pdf* *McGraw Hill, Boston, 2003. web link: http://4lfonsina.files.wordpress.com/2012/11/chemistry_for_environmental_engineering_and_ science.pdf* *C. N. Sawyer, P. L. McCarty, G.F.Parkin: Chemistry for Environmental Engineering and Science.*	
Language, knowledge of which is necessary to complete the subject: English	
Subject evaluation	

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. RNDr. Miroslav Horník, PhD.; MSc. Martin Valica, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KER/md321	**Subject name:** Environmental Quality Assessment Methods
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students pass 2 written exams (need to obtain a total of at least 51% of points to take the exam, corresponding to 30% of the total possible points obtained). The exam takes place in written and oral form. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of this subject, students will gain: – knowledge of testing, monitoring and analytical methods currently used in practice to monitor, analyze and evaluate environmental quality; – knowledge that expands and / or enriches the knowledge acquired in other subjects; competencies in the selection of appropriate and relevant methods for monitoring, analyzing and evaluating the quality of the environment.	
Brief content of the subject: The subject will focus on the presentation of methods and techniques that are directly applied in the workplace in solving various environmental issues, scientific projects or expertise related to the impacts of anthropogenic and natural environmental burdens on living systems, environmental biomonitoring, environmental quality assessment or remediation. Preliminary syllabus: 1. Overview of current methods and techniques of environmental quality monitoring. 2. Sampling methods and design of water resources sampling. 3. Water quality analyzes (in situ measurements of water quality parameters, monitoring of algae, trace elements or metalloids in natural waters, organic components in natural waters). 4. Approaches to biomarker analysis in ecotoxicological biomonitoring at different levels of the biological organization. 5. Soil and sediment analysis (problem identification). 6. Remediation of soils and sediments. Sampling, sample preparation, methods for determining physical parameters, qualitative criteria for soils and sediments. 7. Air purity. Air quality monitoring systems. 8. Aerosol sampling and analysis. Trace emission measurements. 9. Chemometric tools and techniques in environmental monitoring. 10. Selected chapters from methods applied in real studies carried out in the workplace – soil analysis. 11. Selected chapters from methods applied in real studies carried out in the workplace – water analysis. Selected chapters from methods applied in real studies carried out in the workplace – analysis of microbial contamination.	

Recommended literature:

BURDEN, F. R., FOERSTNER, U., MCKELVIE I. D., GUENTHER, A. 2002. Environmental Monitoring Handbook. The McGraw-Hill Companies, Inc. ISBN: 978-00-713517-6-8.

MORRIS, P., THERIVEL, R. 2009. Methods of Environmental Impact Assessment. 3rd edition. Routledge, 576 p. ISBN 978-04-15441-75-9.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Assoc. prof. Mgr. Ildikó Matušíková, PhD.; Assoc. prof. RNDr. Miroslav Horník, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md313	**Subject name:** Exploitation and Conservation of Biological Resources
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Successful completion of the oral exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The student: - acquires knowledge about biological resources (so-called germplasm), their importance for sustainable living on the planet acquire knowledge of methods and procedures that are used to conserve biological resources, in the structure of microorganisms, plants, animals.	
Brief content of the subject: The content of the subject will be 1. biological resources (so-called germplasm) at the level of microorganisms, 2. biological sources (so-called germplasm) at the plant level, 3. biological resources (so-called germplasm) at the animal level, 4. the type, origin, and knowledge of the extent of biodiversity (phenotypic and genotypic), 5. quantitative and qualitative variability applicable in agriculture and nutrition, 6. quantitative and qualitative variability usable in industry, 7. quantitative and qualitative variability applicable in medicine and other sectors. 8. knowledge of ways to obtain and characterize biodiversity, 9. methods of long-term preservation (conservation) of biodiversity (in situ, ex situ, in vitro, cryopreservation, DNA banks), 10. genetic resource management, 11. specialized technical facilities designed for the sustainable conservation of biodiversity in biological resources I 12. specialized technical facilities designed for the permanent conservation of biodiversity in biological resources II	
Recommended literature: *FAO: Cryoconservation of animal genetic resources. FAO Animal Production and Health Guidelines No. 12. Rome, 2012, pp. 222, ISBN 978-92-5-107306-3* *FAO, ITPS, GSBI, CBD and EC: State of knowledge of soil biodiversity - Status, challenges and potentialities, Report 2020. Rome, FAO, 2020, pp. 616, ISBN 978-92-5-133582-6* *Jaramillo, S., Baena, M.: Ex situ conservation of plant genetic resources: training module. IPGRI, 2002, pp. 229, ISBN 978-92-9043-751-2*	

Levin, S.A. (ed.): Encyclopedia of Biodiversity, 2nd ed., Elsevier Inc., 2013, pp. 5484, ISBN 978-0-12-384719-5
Lo, Y.-H. et al: Biodiversity in Ecosystems: Linking Structure and Function, InTech, 2015, pp. 627, ISBN 978-953-51-2028-5

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Prof. RNDr. Ján Kraic, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

University of Ss. Cyril and Methodius in Trnava
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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava

Faculty/institute: Faculty of Natural Sciences

Subject code: KCH/md338 | **Subject name:** Forensic Chemistry

Type, scope, and method of educational activities: Compulsory optional subject.
Subject type (C, CO, O): CO
Recommended scope of teaching (in hours): 2 hours of lectures per week
Study method: on-site
Study form: full-time study

Number of credits: 3

Recommended semester/trimester of study: semester 3

Level of study: master

Prerequisite subjects: without prerequisite subjects

Conditions for completing the subject:
There will be two written examinations of 10 points each during the semester, with at least 19 points for grade A, at least 18 points for grade B, at least 16 points for grade C, at least 14 points for grade D and at least 12 points for grade E.
Overall evaluation of the course:
A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>;
B - very good (above the average standard but with some errors) = 1.5 <83-91 %>;
C - good (generally sound work with a number of notable errors) = 2 <74-82 %>;
D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>;
E - sufficient (performance meets the minimum criteria) =3 <56-64 %>;
FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>

Educational outcomes:
The student will be able to master
- screening methods, sample preparation for microanalysis,
- principles of chemical methods used in forensic chemistry.

Brief content of the subject:
1. Materials and their characterization in forensic chemistry.
2. Sampling strategy, transport and storage.
3. Quality assurance in forensic analysis, decision analysis, legislative aspects.
4. Screening methods, targeted and non-targeted.
5. Principles of inorganic and organic microanalysis.
6. Separation methods in forensic analysis.
7. Applied methods of atomic and molecular spectrometry.
8. Sensors and bioanalytical procedures.

9.-12. Databases, experimental data evaluation strategies.

Recommended literature:
Bell, S.: Forensic Chemistry. Prentice Hall, 2006.
Khan, J., Kennedy, T.J., Christian, D.: Basic Principles of Forensic Chemistry. Humana Press, 2011.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: prof. Ing. Ernest Beinrohr, DrSc.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

University of Ss. Cyril and Methodius in Trnava
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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KER/md337	**Subject name:** Imaging Techniques
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures and 1 hour of seminar per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Acquired knowledge and competencies of students will be tested during the semester by 2 tests, while to the final exam will be admitted only those students who reach min. 50% of points from these continuous tests. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of this subject, the student will gain: – knowledge of light properties, light-based technologies as well as their use in environmental applications; – knowledge and competencies in imaging principles and biophotonic applications, as well as the latest imaging methods; – skills in the processes of design, creation and implementation of the imaging experiment; – skills and competencies in various imaging methods using microscopy, spectroscopy as well as advanced biophotonic methods; – knowledge of specialized imaging applications, including monitoring of fluorescence, autofluorescence and bioluminescence phenomena in living cells and organisms and the interaction of light with a living organism.	
Brief content of the subject: 1. Basics of light imaging and its principles, wave equation, properties of light, light sources (lasers, pulsed light, LED). 2. Basics of biophotonics - sciences of light interactions with living matter (absorption and transmission, diffusion and reflection, interference and diffraction, polarization). 3. Experimental basics of imaging (optical detectors and sensors, mirrors and lenses, optical repositories, principles of bioimaging, sample preparation). 4. Living systems and light (bioluminescence, endogenous and exogenous fluorescence, phosphorescence, respiration and photosynthesis, circadian rhythms). 5. Introduction to spectroscopy (absorption, emission, UV, VIS, NIR, mass, atomic). 6. Basic imaging techniques (optical methods, time resolution, microscopic imaging). 7. Basics of microscopy. Microscopic methods, detectors, types of microscopic imaging 8. Advanced imaging techniques (time-resolved imaging, optical coherence tomography OCT and CARS, Raman spectroscopy, magnetic resonance imaging, multiphoton imaging, near infrared imaging NIR) and their in environmental and biomedical applications. 9. Interaction of light radiation with a living organism (mechanism of light interaction with the body, optical properties of the skin, the eye and other biological tissues). Diagnostic imaging methods, skin imaging, plant leaf imaging.	

10. Macro-imaging: use of LIDAR, employment of lasers in agriculture and in environmental sciences. Monitoring quality of air, water, soil or food in regard to possible contaminants and pollutants, identification of heavy metals by optical methods, determination of food quality and water purity, IR spectroscopy applications.
11. Fourier Transform (FTIR) and Raman spectroscopy. Online monitoring systems to capture e.g. the presence of pollen in the air or drinking water, or analyzes of the fluorescence of algae and plankton in the oceans, processing of large data.
12. Imaging in the future (nanobiophotonics, optical biopsy and nanosurgery, preparation of optical biochips, optical detection of pathogens and monitoring of drug effects, personalized medicine using biophotonic applications, 3D macro printing and micro level, safety applications, imaging methods of quality assessment, indicators and bioindicators of environmental quality).
13. Data processing: methods of big data processing.
14. Safety of work with non-ionizing radiation.

Recommended literature:

POPP, J., TUCHIN, V., CHIOU, A., HEINEMANN, S.H. 2012. Handbook of Biophotonics, Wiley.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: prof. Mgr. Alžbeta Marček Chorvátová, DrSc.; Mgr. Ignác Bugár, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

University of Ss. Cyril and Methodius in Trnava
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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KER/md335	**Subject name:** Influences of Stress Factors on Biota
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 3 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students will prepare a semester presentation (20% of the overall assessment). The exam is written (40% of the overall assessment) and oral (40% of the overall assessment). **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of this course, students will gain: – knowledge of the basic environmental factors and their impacts on the vitality and health of organisms in different ecosystems; – knowledge of the perception of stressors and the responses of organisms to these stimuli; – knowledge of the role of human as an important stress factor and to understand its impact on living nature in terms of its biological and cultural evolution.	
Brief content of the subject: 1. The nature of the environmental crisis and its impact on biotic and abiotic components of the environment. 2. Physical and chemical characteristics of stress factors from various natural and anthropogenic resources and their transformation in time and space. 3. Definitions of stress. Stress intensity, chronic stress. 4. Territorial system of stress factors. 5. Biology of animal stress: metabolic adaptations, immune system responses, neuroendocrine responses. 6. Impacts of stress on developmental processes. 7. Biology of plant stress: mechanisms of perception of environmental stimuli. 8. Biology of plant stress: oxidative stress, synthesis of metabolites with various functions, production of stress proteins, changes in hormone levels. 9. Hypersensitive reaction, systemically acquired resistance and induced systemic reaction. 10. Influences of specific types of stressors (temperature extremes, water regime, toxic elements and substances, insufficient nutrition, etc.). 11. Case studies: impact of heavy metals on plants. 12. Influence of lack of moisture and wind on plants.	
Recommended literature: *RUSHEN, J. 2000. The biology of animal stress: basic principles and implications for animal welfare. CABI Publishing, 355 s. ISBN 978-08-519935-9-1.* *PESSARAKLI, M. 2019. Handbook of Plant and Crop Stress, 4. vyd. Boca Raton: CRC Press. ISBN 978-08-15390-82-4.*	

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Language, knowledge of which is necessary to complete the subject: English					
Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. prof. Mgr. Ildikó Matušíková, PhD.; RNDr. Monika Bardáčová, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

University of Ss. Cyril and Methodius in Trnava
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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md3	**Subject name:** Introduction to Biophysics
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: Attendance at lectures. In total, the student can get a maximum of 500 points. It is necessary for the student to get at least 50% of points. The evaluation of the exam is: 330 - 364 points "E", 365 - 399 points "D", 400 - 434 points "C", 435 - 469 points "B" and 470 - 500 points "A". **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of the course, the student will - acquire basic knowledge in the field of biophysics, from molecular, cellular, to medical, environmental and radiation biophysics, - learn to use physical procedures and methods to study the functions, structures and energetics of biological objects in an effort to accurately describe physico-chemical biological processes - get acquainted with the fundamental characteristics of the living system, as well as with the functioning of molecules in living cells, - acquire basic knowledge about the electrical properties of cells, including the transfer of action potential, cell bioenergetics, as well as nanotechnologies and systems biology - - gain knowledge about the use of biophysics in various fields of physics.	
Brief content of the subject: 1. Biopolymers: mass organization, structure and function of biomacromolecules, (primary to quaternary structure of proteins, ribonucleic acids, sugars and fats), their role in the biological organism, conformational changes and states, interactions between biomacromolecules. 2. Morphology of cells and organs: membrane structure, permeability, cell wall, intracellular and extracellular environment, extracellular matrix, microenvironment of cells. 3. Intercellular signaling: Signaling pathways in the cell, signaling molecules and receptors, regulatory and control mechanisms, enzyme function, intercellular mass. 4. Cellular energetics: ATP production: mitochondria and chloroplasts, oxidative phosphorylation, photosynthesis. 5. Microtubules: cytoskeleton, acto-myosin complex, muscle fibers, polymerization, use in muscle function, secretion, 6. Cell excitability: electrical properties of the cell membrane, ion channels, Nernst equation, resting potential and action potential formation, Goldman-Hodgkin-Katz equation, signal transmission, synaptic transmission, calcium regulation in muscles, electrophysiology and diseases of ion channels, plant excitability, 7. Intracellular signaling: calcium regulation during secretion, lipid transmission and hormonal regulation, cytoskeleton and polymerization.	

8. Interaction of living system and radiation: mechanism of radiation effect, solar spectrum, bioluminescence, endogenous fluorescence,
9. Basics of hierarchy: composition of living matter from viruses, through bacteria, multicellular organisms (plants and animals) to the ecosystem.
10. Population biophysics: hierarchical system and its dynamics, example of a rainforest
11. Basics of biophysical methods: optical methods (microscopy, spectroscopy), resonance methods (laser applications, magnetic resonance methods, CARS).
12. Calorimetry, electrodes (conductometry, voltammetry, pH measurement).

Recommended literature:

B. Alberts et al., 2014: Molecular Biology of the Cell (Textbook), 6th od. Garland Science
Bert Kappen, 2008: Introduction to biophysics, http://www.snn.ru.nl/~bertk/biofysica/handouts.pdf.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: prof. Mgr. Alžbeta Marček Chorvátová, DrSc.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

University of Ss. Cyril and Methodius in Trnava
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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KER/md336	**Subject name:** Metal Recycling Biotechnology
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 3 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: To pass the course successfully students must take a written examination in the 8th week of the semester. The student must obtain at least 51%. The evaluation of the course consists of the evaluation of the written examination (min. 16 points, max. 30 points) and the oral examination (min. 36 points and max. 70 points). Overall, the student can obtain 100 points. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of this subject, the student will gain: – knowledge of the application of microbial processes in the processing of low-grade ores and waste; – knowledge of the mechanisms of individual processes, optimal parameters needed for the implementation of the mentioned processes in practice; – competencies to implement knowledge from successful applications in practice.	
Brief content of the subject: 1. Introduction to the field. 2. Possibilities of microorganisms´ utilization in metal processing. Definition of biometallurgy. History of biometallurgy. 3. Characteristics of organisms used in metal processing. 4. Recovery of metals from solid materials - bioleaching. Characteristics and mechanisms. 5. Bioleaching processes set ups. 6. Case study – Bioleaching plant in Talvivaara, Finland. 7. Applied bioleaching processes in practice. 8. Bioleaching by heterotrophic organisms. Bioleaching of gold. 9. Biological waste recycling. 10. Biotechnological removal of metals from fossil fuels. 11. Biotechnologies suitable for metal recovery from solutions. 12. Use of the principles of circular economy in biological waste treatment.	
Recommended literature: *YAMANAKA, T. 2008. Chemolithoautotrophic bacteria (Biochemistry and Environmental Biology). Springer.* *EHRLICH, H.L., NEWMAN, D.K. 2009. Geomicrobiology. London: CRC Press.*	
Language, knowledge of which is necessary to complete the subject: English	
Subject evaluation	

A	B	C	D	E	FX

0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: prof. RNDr. Jana Sedláková, PhD.; Assoc. prof. RNDr. Miroslav Horník, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md319	**Subject name:** Molecular Biology and Human Genetics
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures and 1 hour of seminar per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: i) Participation at the lectures in accordance with the UCM Study Regulations; ii) Preparation and presentation (powerpoint) of a current topic in the field of human genetics and experimental medicine; iii) Active participation in seminars, asking questions about presentations, discussion (consideration in the overall evaluation of the course) iv) Oral examination. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of the course, the student will: - gain current knowledge about research in the field of molecular biology and human genetics - gain an overview of the latest methods and trends in the research of human genetic diseases, their diagnosis as well as treatment strategies for these diseases - obtain the latest information on currently studied topics in clinical genetics, on the progress of molecular biology methods in human pathology research and on the application of this knowledge in practice.	
Brief content of the subject: 1. *Introduction to human genetics and genomics*: Summary of basic genetic principles; Brief overview of genome sequencing methods and sequencing data analysis; Human genome project 2. *Regulation of gene expression and human epigenome:* Epigenetic mechanisms: DNA methylation, RNA interference, histone remodeling; Human Epigenome Project; Diseases related to epigenetic mechanisms 3. *Variability of the human genome and its detection:* Evolution of the human genome; Haplogroups; Mutations vs. variability; Methods for detecting genome variability 4. *Cytogenetics* - chromosomal aberrations and their diagnostics: Molecular replication of cells; Chromosome structure; Cytogenetics in medical genetics; Chromosome aberrations and prenatal diagnostics 5. *Autosomal inheritance and autosomal dominant diseases:* Molecular basis of heredity; Diagnosis and research of autosomal dominant traits; Autosomal dominant diseases and their research 6. *Rare genetic diseases and their research:* Diagnosis and research of recessively inherited traits; Characteristics of rare genetic diseases; Examples of currently studied recessive diseases; Limits of research on rare genetic diseases	

7. *Diseases associated with sex-linked inheritance and non-nuclear inheritance:* Molecular principles of gender-based inheritance; X-linked pathologies; Mitochondrial DNA, heteroplasmy and related diseases
8. *Multifactorial genetic diseases and risk factors:* Complex traits - traits affected by multiple genes; Molecular principles of complex genetic diseases; Risk factors and probability of disease; Civilization diseases
9. *Genetics of metabolic disorders:* Biochemical basis of metabolism; Genes responsible for metabolic disorders; Manifestations and diagnostics of metabolic disorders
10. *Possibilities and strategies of therapy of genetic diseases:* Therapeutic strategies; Identification of target molecules for therapeutic purposes; Drug approval process
11. *Gene therapy*: Molecular principles of gene therapy; Current advances in gene therapy; Clinical trials; Diseases treated with gene therapy
12. *Personalized medicine:* Personalized genetics and genomics; Disease prevention; Prenatal diagnosis options; Ethical issues related to personalized medicine
13. *Research of genetic diseases in Slovakia and in the world:* Current scientific studies in the field of clinical genetics; Medical research in Slovakia, the EU and the world

Recommended literature:

Jorde, L. B., Carey, J. C., & Bamshad, M. J. (2019). Medical genetics, 6th edition. Elsevier Health Sciences

Turnpenny, P. D., & Ellard, S. (2016). Emery's Elements of Medical Genetics. Elsevier Health Sciences

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: prof. RNDr. Juraj Krajčovič, CSc.; Mgr. Dominika Vešelényiová, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md333	**Subject name:** Mycology
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	

Conditions for completing the subject:

i) Participation in teaching in accordance with the UCM Study Regulations in Trnava;
ii) There will be 2 written examination (20+20%) during the semester;
iii) Active participation in lectures, asking questions for presentations, discussion (consideration in the overall evaluation of the course)
iv) The exam will be realized in written (30%) and oral forms (30%).

Overall evaluation of the course:

A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>;
B - very good (above the average standard but with some errors) = 1.5 <83-91 %>;
C - good (generally sound work with a number of notable errors) = 2 <74-82 %>;
D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>;
E - sufficient (performance meets the minimum criteria) =3 <56-64 %>;
FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>

Educational outcomes:

Upon successful completion of the subject, student:

- will gain an overview of the latest knowledge in the field of systematics, cytology and morphology, ecology as well as products (fungal enzymes, organic acids, antibiotics, mycotoxins) of microscopic filamentous fungi usable in various industries.
- There is the more or less specific mycocenosis on each substrate, so the student will also gain knowledge about negative and positive significance of the most important representatives of microscopic fungi, yeasts and similar organisms, their ecology and occurrence.
- The course of Mycology also builds on students' knowledge acquired during their studies from the courses Basics of Microbiology, Microbiology and Food Microbiology.

Brief content of the subject:

1. The position of microscopic fungi in living nature. Introduction to the course and scientific field of mycology, and its characteristics. Basic concepts in mycology. The growth, nutrition and reproduction of microscopic fungi. Fundamentals of taxonomy. Cytological and morphological characteristics of microscopic fungi. Factors influencing the growth and reproduction of fungi. Basic identification features of microscopic fungi (macromorphological, micromorphological and chemotaxonomic features).
2. The Kingdom Protozoa: Taxa Acrasiomycota, Myxomycota, Plasmodiophoromycota, Hyphochytriomycota. The Kingdom Chromista: characteristics of the Phylum Oomycota, Basidiomycota (macroscopic fungi), classes Ustilaginomycetes (genera Tilletia, Ustilago), Urediniomycetes (genus Puccinia).
3. Characteristics of the Phylum Ascomycota (part 1): general characteristics, system, sexual reproduction (pockets, ontogenesis of fruiting bodies, fruiting bodies), and significance. Macroscopic, microscopic characteristics, and significance of the most important representatives according to the sexual mode of reproduction of the class Eurotiales (genus: Eurotium, Talaromyces), class Sordariales (genera: Chaetomium, Neurospora, Sordaria).
4. Characteristics of the taxon Ascomycota (part 2): asexual reproduction (conidiogenesis, conidia), macroscopic, microscopic characteristics and significance of the most important members of the class

Hyphomycetes according to the asexual method of reproduction (genera: Aspergillus, Fusarium, Alternaria, Cladosporium, Botrytis).
5. Characteristics of the taxon Ascomycota (part 3): macroscopic, microscopic characteristics and significance of the most important members of the class Hyphomycetes according to the asexual method of reproduction (genera: Penicillium, Paecilomyces, Acremonium, Trichoderma) and class: Coelomycetes (genera: Epicoccum, Phico)
6. Characteristics of taxon Zygomycota, Class: Trichomycetes, Zygomycetes - systematic classification, morphology, cytology, reproduction, significance. Macroscopic and microscopic characteristics, reproduction, and significance of the most important members of the class Zygomycetes (genera: Mucor, Absidia, Rhizopus, Syncephalastrum, Zygorrhynchus).
7. Fungi in the environment: mycorrhiza, occurrence of fungi on various substrates (thermophilic, psychrophilic, coprophilic, soil fungi, symbiotic, saprophytic, parasitic fungi, entomogenic fungi), fungal plant pathogens, fungal human pathogens, keratinophilic fungi (dermatophytes).
8. Products of microscopic filamentous fungi and their use: fungal metabolism, fungal products (antibiotics, pharmacologically active compounds, organic acids, vitamins, pigments, enzymes).
9. Toxicogenic microscopic fungi: production and characteristics of mycotoxins, occurrence, and significance, mycotoxicosis.
10. Yeasts and similar organisms: general characteristics, classification into the system, cytological and morphological characteristics of yeasts, factors influencing the growth and reproduction of yeasts. Characteristics of the taxon Ascomycota: class Saccharomycetes (genera: Candida, Dipodascus, Saccharomyces).
11. Yeasts and similar organisms: reproduction of yeasts (sexual, asexual), nutrition and metabolism of yeasts, occurrence, and importance of yeasts in food and biotechnology.
12. Methods used in mycological analyzes (isolation, observation, identification of fungi, chemical methods for determining the presence of microscopic fungi, biochemical methods, molecular biological methods).
13. The Kingdom: How Fungi Made Our World (documentary, director: ANNAMÁRIA TÁLAS, Canada), Fantastic Fungi (documentary, director: Louie Schwartzberg).

Recommended literature:

KAVANAGH, KEVIN. 2017. Fungi, Biology and Applications. Third edition. New York, USA: John Wiley and Sons Ltd, 422 s. ISBN 978–11–1937–432–9. https://www.infogate.sk/?fn=ResultFormChildQ1145K&seo=Zoznam-kn%C3%ADh-|-InfoGate

MANOHARACHARY, C. – TILAK, K. V. B. R. – MALLAIAH, K. V. – KUNWAR, I. K. 2016. Mycology and microbiology (A textbook for UG and PG courses). Scientific Publishers. 607 s. ISBN 978–81–7233–991–3.

WEBSTER, J. – WEBER, R. 2007. Introduction to fungi. Third edition. Cambridge university press. 841 s. ISBN 978–0–521–01483–0.

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: prof. RNDr. Juraj Krajčovič, CSc.; Ing. Miroslava Hlebová, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava

Faculty/institute: Faculty of Natural Sciences

Subject code: KBT/md320 | **Subject name:** Pharmaceutical Botany

Type, scope, and method of educational activities: Compulsory optional subject.
Subject type (C, CO, O): CO
Recommended scope of teaching (in hours): 2 hours of lectures per week
Study method: on-site
Study form: full-time study

Number of credits: 3

Recommended semester/trimester of study: semester 2

Level of study: master

Prerequisite subjects: without prerequisite subjects

Conditions for completing the subject:

i) Participation in teaching in accordance with the UCM Study Regulations in Trnava;
ii) Students present the results of individual study in the form of seminar papers and presentations. The preparation and form of the presentation will be evaluated, 50% of the written part of the works, 50% of the presentations.

Overall evaluation of the course:

A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>;
B - very good (above the average standard but with some errors) = 1.5 <83-91 %>;
C - good (generally sound work with a number of notable errors) = 2 <74-82 %>;
D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>;
E - sufficient (performance meets the minimum criteria) =3 <56-64 %>;
FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>

Educational outcomes:

Upon successful completion of this subject the student:

- knows pharmaceutically important families of medicinal and poisonous plants,
- acquires basic knowledge of the principles of collection, treatment and handling of medicinal plants,
- acquires knowledge of herbal active ingredients.

Brief content of the subject:

1. History of medicinal plants collection, correct principles of medicinal plants collection
2. Adjustment, drying and storage of drugs
3. Use of medicinal plants in the preparation of herbal preparations
4. Introduction to pharmacognosy, basic concepts, active substances of medicinal plants and drugs
5. Plants dangerous to life and health
6. - 11. Characteristics of selected medicinal plants

12. - 13. Final presentation of papers

Recommended literature:

Chevallier A.: Encyclopedia Of Herbal Medicine. Dorling Kindersley Ltd., 2016.
Ody P.: The complete medicinal herbal. Skyhorse Publishing, 2017.
Ramzan I.: Phytotherapies: Efficacy, Safety, and Regulation. John Wiley & Sons, Inc., 2015
Markovics J.: Poisonous Plants. Cherry Lake Pub. 2021.
Nelson L. S., Shih R. D., Balick M. J.: Handbook of Poisonous and Injurious Plants. SpringerLink, 2020

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: Assoc. Prof. RNDr. Ľubica Uváčková, PhD.; Ing. Eva Ürgeová, PhD.

Date of last change: 28.02.2022

University of Ss. Cyril and Methodius in Trnava
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Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md318	**Subject name:** Proteomics
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students take two semester tests, which will be scored. In order to be admitted to the exam, a student must obtain more than half of the points in the sum of both semester tests. Credits will not be awarded to a student who earns less than half of the points and they will not be admitted to the exam, too. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The course provides an overview of knowledge from proteomics scientific discipline. Students • get acquainted with the work with proteins, proteomic approaches and methods of proteomic research with emphasis on the field of application • also gain knowledge of methods for protein identification by mass spectrometry in combination with bioinformatics tools.	
Brief content of the subject: 1. Introduction to proteomics 2. Scheme and classification of current proteomics. Options, tools and limitations. 3. Working with proteins. Protein properties. Peptides. Amino acids. Protein types. Posttranslational modifications. 4. Proteomic analysis. Isolation, separation, identification. Classic strategy vs. Shot-gun strategy. 5. Proteomic analysis. Basic procedures for protein isolation. Methods for determining protein concentration. Contamination in the sample. 6. Proteomic analysis. Protein separation. Non-chromatographic methods and chromatographic methods. 7. Proteomic analysis. Two-dimensional electrophoresis. Sample preparation. Isoelectric focusing. PAGE. 8. Detection of proteins on gels. Advantages of individual detection methods. Possibilities and limitations. 9. Image analysis of 2D gels. Principle. Software. Evaluation. Interpretation. Advantages and disadvantages of 2DE. 10. Mass spectrometry. Principle. MALDI. ESI. 11. Proteomic analysis. Identification of proteins using MS. Sample preparation for mass spectrometry identification. Protein cleavage. 12. Proteomic bioinformatics. Proteomic databases and tools. Utilization.	

13. Applications of proteomics. Possibilities of use in basic and applied research.					
Recommended literature: *Lesk, A.M.: Introduction to Protein Sciences. Oxford University Press. 2004, ISBN-13: 978-0199541300* *Twyman, R.M.: Principles of proteomics, Taylor and Francis, 2nd edition, 2013, ISBN 9780815344728*					
Language, knowledge of which is necessary to complete the subject: English					
Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. RNDr. Ľubica Uváčková, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KBT/md315	**Subject name:** Radioecology
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures and 1 hour of seminar per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: The acquired knowledge and competencies of the students will be tested during the semester by 2 intermediate tests, while only students who achieve a minimum of 50 % of the points from these intermediate tests will be admitted to the final exam. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of this subject, the student will gain: – knowledge and competencies on the origin of contamination of the atmosphere, hydrosphere and pedosphere by sources of ionising radiation; – knowledge of the behaviour of radionuclides in environmental compartments; – deeper understanding and competencies in the application of the principles of radiation monitoring and radionuclides geomigration.	
Brief content of the subject: Stages in the development of radioecology and the position of radioecology in the system of natural sciences. 2. Repertory of selected quantities and units applied in nuclear sciences. 3. Pathways of radionuclide transfer from source to man. Biological effects of ionizing radiation. 4. Sources of natural radioactivity and background radiation. Primordial radionuclides and radionuclides of the decay series. Cosmogenic radionuclides. 5. Radioactivity of the atmosphere, hydrosphere and pedosphere. 6. Anthropogenic environmental radioactivity. Nuclear testing and nuclear power plants. 7. Nuclear accidents and incidents and their impact on the environment. 8. Fundamentals of radiation protection. 9. Methods of environmental contamination control. Monitoring methods. 10. Monitoring of radioactive discharges of SE EBO, JAVYS VI, JAVYS-JE A1, RÚRAO Mochovce. Contamination of the surroundings of NPP Jaslovské Bohunice and Mochovce. 11. Local monitoring networks of nuclear facilities. Monitoring of the radiation situation in the Slovak Republic. 12. Laboratory and mobile methods. Fundamentals of radionuclides geomigration.	
Recommended literature: *ATWOOD, D. 2010. Radionuclides in the environment. New York: Wiley, 522 p. ISBN 978-0-470-71434-8.* *RANDLE, K. – SOKHI, R. – COOPER, J. 2003. Radioactive releases in the environment: Impact and assessment. New York: Wiley, 490 p. ISBN 978-0-471-89923-5.*	

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Language, knowledge of which is necessary to complete the subject: English					
Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. RNDr. Miroslav Horník, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KER/md334	**Subject name:** Remediation Technology
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures and 1 hour of seminar per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	

Conditions for completing the subject:

Regular attendance at laboratory exercises, submission of all laboratory reports. During the semester, students will complete small written tests before each laboratory exercise (the requirement for complete the exercise is a minimum score of 51 %, the points for all written tests represent 50 % of the course evaluation). Students will submit a laboratory protocol for each laboratory exercise (the requirement for complete the exercise is a minimum score of 51 % for the protocol, points for all protocols represent 50 % of the subject evaluation).

Overall evaluation of the course:

A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>;
B - very good (above the average standard but with some errors) = 1.5 <83-91 %>;
C - good (generally sound work with a number of notable errors) = 2 <74-82 %>;
D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>;
E - sufficient (performance meets the minimum criteria) =3 <56-64 %>;
FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>

Educational outcomes:

Upon successful completion of this subject, the student will gain:
– skills and experiences in the application of selected remediation techniques and methods based on physical, chemical and biological principles;
– skills and experiences in the application of selected remediation techniques based on removal of heavy metals, radionuclides and organic contaminants (xenobiotics) from polluted waters and soils;
– competencies in assessing the effectiveness and relevance of the application of remediation techniques and methods for specific environmental problems.

Brief content of the subject:

1. Principles of work safety in the chemistry and isotope laboratory.
2. Electrochemical removal of synthetic dyes or pharmaceuticals from contaminated waters.
3. Microbiological removal of synthetic dyes from contaminated waters.
4. Chemical oxidation/reduction of contaminants.
5. Chemical precipitation of heavy metals.
6. Chemical leaching of heavy metals from contaminated soils.
7. Use of inorganic sorbents in the removal of synthetic dyes, heavy metals or radionuclides from polluted waters.
8. Bioaccumulation and biosorption of synthetic dyes, heavy metals or radionuclides from polluted waters.
9. Removal of heavy metals or radionuclides from contaminated waters or soils by plants (phytoremediation).
10. Vacuum extraction of organic contaminants from contaminated soils.
11. Solidification of contaminated materials into polymer matrices.
12. Evaluation of laboratory exercises.

Recommended literature:

HASANUZZAMAN, M. et al. 2020. Handbook of Bioremediation. New York: Academic Press, 764 p. ISBN 978-01-28193-83-9.

OK, Y.S. et al. 2020. Soil and Groundwater Remediation Technologies. Boca Raton: CRC Press, 350 p. ISBN 978-04-29322-56-3.					
Language, knowledge of which is necessary to complete the subject: English					
Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: Assoc. Prof. RNDr. Miroslav Horník, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md312	**Subject name:** Selected Chapters in Virology
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures and 1 hour of seminar per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	

Conditions for completing the subject:

i) Participation in lectures in accordance with the Study Regulations of UCM in Trnava;
ii) Preparation and active presentation of a seminar work from the field of virology; processing of scientific literature
iii) Active participation in seminars and in the discussions on the subject (will be considered during the whole course)
iv) Written exam (test + open questions).

Overall evaluation of the course:

A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>;
B - very good (above the average standard but with some errors) = 1.5 <83-91 %>;
C - good (generally sound work with a number of notable errors) = 2 <74-82 %>;
D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>;
E - sufficient (performance meets the minimum criteria) =3 <56-64 %>;
FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>

Educational outcomes:

Upon successful completion of the subject, the student

- gains more detailed knowledge in the fields of general and applied virology
- deepen the knowledge acquired in previous courses related to virology
- the presented topics will respond to the latest and current knowledge in dynamically evolving field of virology, such as identification and emergence of new viruses, advanced diagnostic methods, molecular epidemiology and characterization of specific infectious agents (viroids, prions).

Brief content of the subject:

The areas presented in the course will touch on several levels - synthesis of knowledge from basic research in virology, analysis of new, attractive and interesting studies, results of applied research in practice and innovative methods used in virology.

1. Viruses and symbiosis with the host organism, examples of mutualistic relations of viruses with their hosts.
2. Molecular epidemiology and evolution of plant viruses.
3. Evolutionary mechanisms shaping the variability of plant viruses.
4. Diversity of plant viruses in relation to pathogenesis.
5. New and emerging viruses in humans, livestock, plants, their characterization, pathogenesis and ecology.
6. New and innovative procedures in the diagnosis of plant viruses.
7. Use of massive parallel sequencing in plant virus analysis, virus genome identification and characterization.
8. Viroids, their origin, evolution and molecular variability.
9. Importance of viroids for RNA technologies. Prions and prion infections, slow viral infections.
10. Rodent-borne viruses and new insights in their researcht
11. Molecular epidemiology of arboviruses (viruses transmitted by arthropods) and the latest trends in their research.
12. New findings from research of viruses with pandemic potential (coronaviruses, influenza virus).

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Recommended literature:

Dimmock NJ et al. (2016) Introduction to modern virology. John Wiley & Sons, Ltd. ISBN: 978-1-119-97810-7

Maliogka VI, Glasa M et al. (2018) Recent Advances on Detection and Characterization of Fruit Tree Viruses Using High-Throughput Sequencing Technologies. Viruses 2018, 10, 436.

Zimmer C (2015) A Planet of Viruses 2nd ed. The University of Chicago Press. ISBN: 978-0-226-29420-9

Lostroh P (2021) Molecular and Cellular Biology of Viruses 1st Edition. CRC Press. ISBN: 978-0815345237

Language, knowledge of which is necessary to complete the subject: English

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Teacher: prof. RNDr. Juraj Krajčovič, CSc.; Ing. Miroslav Glasa, PhD.

Date of last change: 28.02.2022

Approved: Prof. RNDr. Ján Kraic, PhD.

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917 01 Trnava

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KER/md314	**Subject name:** Wastewater Treatment Technology
Type, scope, and method of educational activities: Compulsory optional subject. **Subject type (C, CO, O):** CO **Recommended scope of teaching (in hours):** 2 hours of lectures and 1 hour of seminar per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 3	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: The following criteria will be evaluated in the course (max 100 points): intermediate written exam: max 40 points; final written exam: max 60 points. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: Upon successful completion of this course, the student will gain: – knowledge of wastewater treatment technologies, processes and the technological equipment used in them; – skills in basic calculations related to wastewater treatment processes; – competencies in the application of wastewater treatment technologies in practice and the legislative and regulatory background to their operation.	
Brief content of the subject: 1. Types and characteristics of wastewater, requirements for discharge of water into water body. 2. Sewage networks and systems. 3. Municipal wastewater treatment processes, pre-treatment of wastewater. 4. Primary treatment of wastewater, separation of dispersed substances, sedimentation. 5. Secondary treatment processes, aerobic biological treatment, aeration methods. 6. Secondary treatment processes, anaerobic biological treatment, removal of nitrogen, phosphorus. 7. Sludge management, stabilisation, dewatering, sludge thickening. 8. Tertiary wastewater treatment. 9. Wastewater treatment plant products, utilisation, sludge disposal, biogas. 10. Domestic wastewater treatment plants. 11. Legislative and regulatory background to the operation of wastewater treatment plants. 12. Use of wastewater treatment plants in practice.	
Recommended literature: *SPERLING, M. 2007. Biological wastewater treatment series, Volume 1: Wastestewater Characteristics, Treatment and Disposal, 2007. 304 p. ISBN 1843391619; Volume 2: Basic Principles of Wastewater Treatment, 2007. 208 s. ISBN 1843391627; Volume 3: Waste Stabilisation Ponds, 2007. 175 s. ISBN 1843391635; Volume 4: Anaerobic Reactors, 2007. 188 s. ISBN 1843391643; Volume 5: Activated Sludge and Aerobic Biofilm Reactors, 2007. 336 s. ISBN 1843391651; Volume 6: Sludge Treatment and Disposal, London: IWA Publishing, 256 s. ISBN 184339166X.* *WEINER, R.E. – MATTHEWS, R.A. 2003. Environmental engineering. New York: Elsevier, 484 s. ISBN 0750672943.*	
Language, knowledge of which is necessary to complete the subject: English	

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Subject evaluation					
A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00
Notes:					
Teacher: prof. RNDr. Jana Sedláková, PhD., RNDr. Monika Bardáčová, PhD.					
Date of last change: 28.02.2022					
Approved: Prof. RNDr. Ján Kraic, PhD.					

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Optional subjects

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md323	**Subject name:** Sports Activity I
Type, scope, and method of educational activities: Optional subject. **Subject type (C, CO, O):** O **Recommended scope of teaching (in hours):** 2 hours of seminars per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 2	
Recommended semester/trimester of study: semester 1	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students' active participation in the course will be evaluated, for which the student will be evaluated with a maximum of 100 points. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The aim of the course is to lead students to active leisure and physical activity as part of the quality of life.	
Brief content of the subject: Sport activities offered by UCM and FNS.	
Recommended literature:	
Language, knowledge of which is necessary to complete the subject: English	
Subject evaluation	

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Teacher: Ing. Eva Ürgeová, PhD.
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md324	**Subject name:** Sports Activity II
Type, scope, and method of educational activities: Optional subject. **Subject type (C, CO, O):** O **Recommended scope of teaching (in hours):** 2 hours of seminars per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 2	
Recommended semester/trimester of study: semester 2	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students' active participation in the course will be evaluated, for which the student will be evaluated with a maximum of 100 points. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The aim of the course is to lead students to active leisure and physical activity as part of the quality of life.	
Brief content of the subject: Sport activities offered by UCM and FNS.	
Recommended literature:	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Teacher: Ing. Eva Ürgeová, PhD.
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.

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

SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md340	**Subject name:** Sports Activity III
Type, scope, and method of educational activities: Optional subject. **Subject type (C, CO, O):** O **Recommended scope of teaching (in hours):** 2 hours of seminars per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 2	
Recommended semester/trimester of study: semester 3	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students' active participation in the course will be evaluated, for which the student will be evaluated with a maximum of 100 points. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The aim of the course is to lead students to active leisure and physical activity as part of the quality of life.	
Brief content of the subject: Sport activities offered by UCM and FNS.	
Recommended literature:	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Teacher: Ing. Eva Ürgeová, PhD.
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.

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SUBJECT INFORMATION SHEET

University: University of Ss. Cyril and Methodius in Trnava	
Faculty/institute: Faculty of Natural Sciences	
Subject code: KB/md341	**Subject name:** Sports Activity IV
Type, scope, and method of educational activities: Optional subject. **Subject type (C, CO, O):** O **Recommended scope of teaching (in hours):** 2 hours of seminars per week **Study method:** on-site **Study form:** full-time study	
Number of credits: 2	
Recommended semester/trimester of study: semester 4	
Level of study: master	
Prerequisite subjects: without prerequisite subjects	
Conditions for completing the subject: During the semester, students' active participation in the course will be evaluated, for which the student will be evaluated with a maximum of 100 points. **Overall evaluation of the course:** A - excellent (outstanding performance with only minor errors) = 1 <92-100 %>; B - very good (above the average standard but with some errors) = 1.5 <83-91 %>; C - good (generally sound work with a number of notable errors) = 2 <74-82 %>; D - satisfactory (fair bad with significant shortcomings) = 2.5 <65-73 %>; E - sufficient (performance meets the minimum criteria) =3 <56-64 %>; FX - fail (some more work required before the credit can be awarded) = 4 <0-55 %>	
Educational outcomes: The aim of the course is to lead students to active leisure and physical activity as part of the quality of life.	
Brief content of the subject: Sport activities offered by UCM and FNS.	
Recommended literature:	
Language, knowledge of which is necessary to complete the subject: English	

Subject evaluation

A	B	C	D	E	FX
0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Teacher: Ing. Eva Ürgeová, PhD.
Date of last change: 28.02.2022
Approved: Prof. RNDr. Ján Kraic, PhD.