Appendix 3 No. 1		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**GENERAL AND INORGANIC CHEMISTRY**			
2.	Code	3FMN191925			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	First year / First semester	7.	Number of ECTS	6
8.	Professor	Assoc. Prof. Dr.sc. Aleksandar Cvetkovski			
9.	Pre-conditions for course registration	Enrolled in first semester of studies			
10.	**Aims of the study program (competences):** – Acquiring knowledge in the principles of laws of mass action of matter, reactivity, and aggregate states; – Comparative study on atom models and elementary particle theories; – Comparative study on the periodicity of the elements in the Periodic Table of the Elements and the inorganic substance of the groups of compounds of the chemical elements that are of interest for the application of medicinal substances, auxiliary medicinal substances in pharmacy and medicine, as well as from the ingredients in medicines and for environmental protection.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. Modern approaches in getting to know the structure of matter, substances, mixtures, and chemical reactivity; 2. Electronic configuration of atoms and Periodicity of elements in the Periodic Table of Elements; 3. Chemical bonds and hybridization; 4. Geometry of molecules; 5. Types of chemical reactions in inorganic chemistry; 6. Systematics of non-metals; 7. Systematics of metals from the main groups of the Periodic Table (elements); 8. Systematics of transitional element (d-elements); 9. Systematics of f-elements (lanthanoids and actinoids); 10. Coordination chemistry, chemistry of complex, coordination compounds, including metal-organic compounds of interest for application as drugs in diagnostic purposes. *Practical part:* 1. Calculations based on chemical formulas; 2. Oxidation-reduction equations and calculus; 3. Calculation based on chemical equations (stoichiometric calculations); 4. Solutions, calculation of concentration of solutions, preparation of solutions, dilution of solutions; 5. Concept of pH, concentration of hydrogen and hydroxide ions; 6. Buffers, properties of buffers and preparation of buffers; 7. Buffer capacity; 8. Hydrolysis; 9. Thermochemistry; 10. Energetics of chemical reactions.				
12.	**Study methods:** Lectures, seminars, exercises, individual assignments, collaborative lectures, methods of group discussion.				
13.	Total amount of time available	6 ECTS x 30 hours = 180 hours (3+2)			

14.	Distribution of tasks			45+30+15+45+45	
15.	Types of learning/teaching activities		15.1.	Lectures – theory	45 hours
			15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours
16.	Other types of activities		16.1.	Projects	15 hours
			16.2.	Individual tasks	45 hours
			16.3.	Home study – tasks	45 hours
17.	Evaluation / assessment methods				
	17.1.	Tests			40 points
	17.2.	Individual tasks / project (presentation: written and oral)			10 points
	17.3.	Activity and participation			20 points
	17.4.	Final exam			30 points
18.	Assessment criteria (points / grade)			Up to 50 points	5 (five) (F)
				51 – 60 points	6 (six) (E)
				61 – 70 points	7 (seven) (D)
				71 – 80 points	8 (eight) (C)
				81 – 90 points	9 (nine) (B)
				91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam			60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.	
20.	Language of the study program			English	
21.	Quality assurance methods of the teaching process			Self-evaluation	

22. Literature

Mandatory literature

No.	Author	Title	Publisher	Year
1.	House, J. E.	*Inorganic Chemistry*	Academic Press as an imprint of Elsevier	2008
2.	Weller, M., Overton, T., Rourke, J., Armstrong, F.	*Inorganic Chemistry (7th Edition)*	Oxford University Press	2018

Additional literature

No.	Author	Title	Publisher	Year
1.	Strohfeldt, K. A.	*Essentials of Inorganic Chemistry: For Students of Pharmacy, Pharmaceutical Sciences, and Medicinal Chemistry*	Wiley	2015

Appendix 3 No. 2		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**MATHEMATICS**			
2.	Code	FI100125			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	First year / First semester	7.	Number of ECTS	5
8.	Professor	Assoc. Prof. Dr.sc. Marija Miteva			
9.	Pre-conditions for course registration	Enrolled in first semester of studies			
10.	**Aims of the study program (competences):** Students will gain knowledge from the field of mathematics, which is necessary for solving practical problems related to their profession.				
11.	**Content of the study program (applies both for theoretical and practical part):** *First part:* Operations on the set of real numbers. Degrees. Logarithms. Polynomials. Linear equation and linear inequality. System of linear equations. Quadratic equation and quadratic inequality. Proportionality of quantities (rate, proportion, triple rule, percentage). Calculation of mixtures. Basic elements of combinatorics. *Second part:* Real sequences. Arithmetic and geometric progression. Limit value (limes) of a sequence. Real functions of one real variable. Some elementary functions (linear function, quadratic function, exponential function, logarithmic function). Limit value (limes) of a function. Differentiation of function. Application of real functions of one real variable and their derivatives (practical problems). Indefinite integral. Definite integral.				
12.	**Study methods:** Lectures, exercises, project work.				
13.	Total amount of time available	5 ECTS x 30 hours = 150 hours (2+2)			
14.	Distribution of tasks	30+30+20+20+50			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours	
16.	Other types of activities	16.1.	Projects	20 hours	
		16.2.	Individual tasks	20 hours	
		16.3.	Home study – tasks	50 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	
	17.2.	Individual tasks / project (presentation: written and oral)		10 points	
	17.3.	Activity and participation		20 points	
	17.4.	Final exam		30 points	
18.	Assessment criteria (points / grade)	Up to 50 points		5 (five) (F)	
		51 – 60 points		6 (six) (E)	
		61 – 70 points		7 (seven) (D)	
		71 – 80 points		8 (eight) (C)	
		81 – 90 points		9 (nine) (B)	
		91 – 100 points		10 (ten) (A)	
19.	Eligibility for signature and taking the final exam	60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.			
20.	Language of the study program	English			

<table>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="6">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Miteva, M.</td><td>Internal textbook with lectures and exercises</td><td>Goce Delcev University, Stip</td><td>2024</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
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<table>
<tr><td colspan="2">Appendix 3
No. 3</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">BIOLOGY FOR PHARMACISTS</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN192125</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>First year /
First semester</td><td>7.</td><td>Number of ECTS</td><td>6</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Full Prof. Dr.sc. Nevenka Velichkova</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in first semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
This course covers the structure and function of cells as the basic unit of life, differences between plant and animal cells and biomolecules in cells. The study of modern biological principles and processes, the structure, replication, recombination and expression of prokaryotic and eukaryotic genetic material. Specific topics include DNA to RNA to protein, nuclear and cytoplasmic regulation of macromolecular synthesis, exchange of materials across cell membranes, control of cell growth, cell communication, stem cells and cancer.
The competences of students include:
– ability to prepare microscope slides, view the slides using a light microscope and interpret what you see by composing both overview (tissues) and detailed (cells) drawings;
– recognize organs, tissues and cells from which organism are built up;
– recognize and explain the qualities of classical and modern microscope techniques applied to study tissues and organs;
– use the scientific method and understand its strengths and weaknesses, ability to research a biological topic using traditional and computer technology and more opportunities to obtain fundamental understanding of the cellular processes many drugs ultimately impact;
– critically discuss issues regarding plant life cycles, life forms, reproduction and evolution;
– to use cytological methods used in pharmacy which are especially important and useful in pharmaceutical research.
All the theoretical knowledge that the students gather in this subject are controlled and determined with practical laboratory work and practice.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
The skills above will be developed while students engage in course work focused on the following content:
– Basic and modern microscope techniques;
– Composition of the cell;
– Cell membrane structure and transport through the cell membrane;
– Intracellular junctions;
– Endoplasmic reticulum structure and function;
– Golgi apparatus structure and function;
– Mitochondrial structure and function;
– Structure of lysosomes and peroxisomes and their functions;
– Cytoskeleton, cell division, gene replication and expression;
– Apoptosis and necrosis;
– Cell cycle regulation in normal cells, stem cells and tumor cells;
– Properties of the cells and their interactions as components of tissues and organs;</td></tr>
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<tr><td></td><td colspan="6">– Four basic tissues in complex preparations (in, for instance, a light microscopy section), explaining their functions.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, exercises, seminars, practical activities.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">6 ECTS x 30 hours = 180 hours (3+2)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">45+30+15+45+45</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">45 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="3">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="3">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="3">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="3">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="3">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="3">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="4">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="4">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="7">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Böhmer, D., Repiská, V., Danišovič, L.</td><td>Introduction to medical and molecular biology</td><td>Asklepios Bratislava</td><td>2010</td></tr>
<tr><td>2.</td><td>Ross, M. H., Vojnic, P.</td><td>Cell and molecular biology</td><td>Tabernakul</td><td>2010</td></tr>
<tr><td>3.</td><td>Pollard, T., Earnshaw, W.</td><td>Cell Biology</td><td>Elsevier</td><td>2008</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
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<tr><td colspan="2">Appendix 3
No. 4</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Name of the course</td><td colspan="5">BIOPHYSICS</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="5">3FMN192225</td></tr>
<tr><td>3.</td><td colspan="2">Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td colspan="2">Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td colspan="2">First year /
First semester</td><td>7.</td><td>Number of ECTS</td><td>5</td></tr>
<tr><td>8.</td><td colspan="2">Professor</td><td colspan="5">Full Prof. Dr.sc. Zdenka Stojanovska</td></tr>
<tr><td>9.</td><td colspan="2">Pre-conditions for course registration</td><td colspan="5">Enrolled in first semester of studies</td></tr>
<tr><td>10.</td><td colspan="7">Aims of the study program (competences):
Establishment and extension of basic knowledge of physics and its application in medical science.</td></tr>
<tr><td>11.</td><td colspan="7">Content of the study program (applies both for theoretical and practical part):
– Mechanics and biomechanics, real systems, energy, work and power, elasticity and plasticity;
– Mechanical oscillations and mechanical waves, bioacoustics, ultrasound and its application;
– Biomechanics of fluids, ideal and real fluids;
– Thermodynamics, transport processes;
– Electrical phenomena, electrical signals in the body;
– Physics of electro-diagnostics and electrotherapy;
– Basic phenomena and laws in optics, optical instruments, light effects, vision, lasers and their application in medicine;
– Ionization radiation: generation, interactions, biological effects;
– Physics of nuclear medicine, Radiology and Radiotherapy.</td></tr>
<tr><td>12.</td><td colspan="7">Study methods:
Discussions, laboratory and numerical exercises, homework, home learning.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">5 ECTS x 30 hours = 150 hours (2+2)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">30+30+0+45+45</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">0 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">45 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="3">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="3">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="3">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="3">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="3">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="3">91 – 100 points</td><td>10 (ten) (A)</td></tr>
</table>

<table>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="5">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Stojanovska, Z.</td><td>Lecture notes</td><td>Goce Delcev University, Stip</td><td>/</td></tr>
<tr><td>2.</td><td>Irving, H. P.</td><td>Physics of the Human Body</td><td>Springer</td><td>2007</td></tr>
<tr><td>3.</td><td>Bushberg, J. T., Seibert, J. A., Leidholdt, E. M., Boone, J. M.</td><td>The Essential Physics of Medical Imaging (3rd Edition)</td><td>Lippincott Williams & Wilkins</td><td>2012</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Franklin, K., Muir, P., Scott, T., Willcocks, L., Yates, P.</td><td>Introduction to Biological Physics for the Health and Life Sciences</td><td>Wiley</td><td>2010</td></tr>
</table>

Appendix 3 No. 5		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**INTRODUCTION TO PHARMACY**			
2.	Code	3FMN192325			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	First year / First semester	7.	Number of ECTS	4
8.	Professor	Assoc. Prof. Dr.sc. Elena Drakalska Sersemova			
9.	Pre-conditions for course registration	Enrolled in first semester of studies			
10.	**Aims of the study program (competences):** To enable students to understand the scope and essence of the pharmacist's practical work and their role within the healthcare system, industrial production, regulatory bodies, and research activities. Additionally, to develop a rational, evidence-based approach to problem-solving in practice, grounded in findings from scientific research.				
11.	**Content of the study program (applies both for theoretical and practical part):** – Subject of Pharmacy: Definitions and Professional Opportunities; – Development of Pharmacy: Key Achievements in the 19th and 20th Centuries; – Legal Frameworks Regulating the Pharmaceutical Sector in the Republic of North Macedonia; – European and International Pharmacy Regulations: Process of International Harmonization; – Good Practices: An Essential Component of International Drug Regulations in National Legislation; – Evidence-Based Medicine, Evidence-Based Pharmacy; – The Pharmacy Profession; – Learning and Training; – Pharmaceutical Associations; – Finished Pharmaceutical Product, Drug Quality; – Pharmacy and Hospital Pharmacy; – Ethics in Pharmaceutical Practice.				
12.	**Study methods:** Lectures, interactive teaching, research work.				
13.	Total amount of time available	4 ECTS x 30 hours = 120 hours (2+1)			
14.	Distribution of tasks	30+15+60+30+15			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	15 hours	
16.	Other types of activities	16.1.	Projects	60 hours	
		16.2.	Individual tasks	30 hours	
		16.3.	Home study – tasks	15 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	
	17.2.	Individual tasks / project (presentation: written and oral)		10 points	
	17.3.	Activity and participation		20 points	
	17.4.	Final exam		30 points	
18.	Assessment criteria (points / grade)	Up to 50 points		5 (five) (F)	
		51 – 60 points		6 (six) (E)	

<table>
<tr><td></td><td colspan="3"></td><td>61 – 70 points</td><td colspan="2">7 (seven) (D)</td></tr>
<tr><td></td><td colspan="3"></td><td>71 – 80 points</td><td colspan="2">8 (eight) (C)</td></tr>
<tr><td></td><td colspan="3"></td><td>81 – 90 points</td><td colspan="2">9 (nine) (B)</td></tr>
<tr><td></td><td colspan="3"></td><td>91 – 100 points</td><td colspan="2">10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="8">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Azzopardi, L. M.</td><td>Lecture Notes in Pharmacy Practice</td><td>Pharmaceutical Press</td><td>2010</td></tr>
<tr><td>2.</td><td>Whalley, B. J., Fletcher, K. E., Weston, S. E., Howard, R. L.</td><td>Foundation in Pharmacy Practice</td><td>Pharmaceutical Press</td><td>2008</td></tr>
<tr><td>3.</td><td>Angelovska, B., Ivanovska, V.</td><td>Introduction to Pharmacy</td><td>Goce Delcev University, Stip</td><td>2013</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Krajnovic D., Lakik, D.</td><td>Introduction to Pharmacy</td><td>Faculty of Pharmacy, Belgrade</td><td>2019</td></tr>
</table>

Appendix 3 No. 6		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**ORGANIC CHEMISTRY**			
2.	Code	3FMN192425			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	First year / Second semester	7.	Number of ECTS	7
8.	Professor	Adj. Ass. Prof. Dr.sc. Maja Chochevska			
9.	Pre-conditions for course registration	Enrolled in second semester of studies			
10.	**Aims of the study program (competences):** Providing basic knowledge of theoretical and experimental aspects of organic chemistry, with particular emphasis to the basic organic molecules including alkanes, cycloalkanes, alkenes, alkynes, dienes, alkyl halides, aromatic compounds, alcohols, ethers, phenols, aldehydes, ketones and ethers; Understanding the formulas of organic compounds (writing and naming the main organic molecules); Identifying the main functional groups; Predicting and recognizing the physicochemical Properties and stereochemical properties, reactivity and pharmaceutical importance of the organic molecules; Analyzing the relationship between the structure and the properties of the organic molecules. Student tasks (individual and homework) are planned on the topics covered during the course to achieve higher learning outcomes. Mainly to solve exercises on the reactivity and stereochemistry of the most common classes of organic compounds, and on their IUPAC nomenclature, as well as reaction mechanisms.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* Introduction to organic chemistry and organic compounds in pharmacy; Atomic structure, electronic configuration; Atom formal charge, atomic and molecular orbitals; Simple and multiple covalent bonds; Polar covalent bonds; Acids and bases; Hybridization (sp^3, sp^2 and sp); Molecular geometries; Resonance structures; Stability of intermediates and organic compounds; Intramolecular interactions, physicochemical properties of the main classes of organic compounds, solubility in water and other solvents; Reaction types: Substitution, Addition, Elimination, and Rearrangement; Isomers and stereochemistry; Structural, conformational, geometric isomerism – *cis*/*trans* isomerism, Chain-Ingold and Prelog (CIP) rules, and E/Z descriptors – optical isomerism: chirality, R/S configurations, physicochemical properties and optical activity of enantiomers, diastereoisomers; Kinetics and thermodynamics of organic reactions: correlation between the structural features of organic compounds and pK_a and acid/base properties (structure, substituents, electronegativity, hybridization); Organic compounds: functional groups and classification; Alkanes, Cycloalkanes, Alkenes, Alkynes, Organohalides – Alkyl Halides; Benzene and Aromaticity, Alcohols and Phenols, Ethers and Epoxides; Thiols, Carbonyl Compounds: Aldehydes and Ketones. *Practical part:* Organic nomenclature (practical problems on writing and naming the main organic molecules); Building molecular models using the molecular model kit; Drawing of reaction mechanisms of common types of organic reactions: substitution and addition reactions; Introduction to practical work in organic chemistry (introduction to laboratory safety, basic glassware used in the laboratory, organic chemistry laboratory techniques: extraction, filtration, recrystallization, evaporation, distillation, and thin-layer chromatography); Synthesis of some simple drugs (acetyl salicylic acid, benzamide, iodoform); Extraction, isolation, and purification of an organic molecules used in pharmacy.				
12.	**Study methods:**				

	Theoretical learning methods: frontal teaching through lectures (PPT presentations); *Practical learning methods*: problem-solving tasks (drawing molecules, nomenclature, drawing reaction mechanisms), and laboratory work (laboratory experiments).				
13.	Total amount of time available		7 ECTS x 30 hours = 210 hours (3+3)		
14.	Distribution of tasks		45+45+15+25+80		
15.	Types of learning/teaching activities	15.1.	Lectures – theory	45 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	45 hours	
16.	Other types of activities	16.1.	Projects	15 hours	
		16.2.	Individual tasks	25 hours	
		16.3.	Home study – tasks	80 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	
	17.2.	Individual tasks / project (presentation: written and oral)		10 points	
	17.3.	Activity and participation		20 points	
	17.4.	Final exam		30 points	
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)	
			51 – 60 points	6 (six) (E)	
			61 – 70 points	7 (seven) (D)	
			71 – 80 points	8 (eight) (C)	
			81 – 90 points	9 (nine) (B)	
			91 – 100 points	10 (ten) (A)	
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.		
20.	Language of the study program		English		
21.	Quality assurance methods of the teaching process		Self-evaluation		

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	McMurry, J. E.	*Organic Chemistry (10th Edition)*	OpenStax	2023
2.	Clayden, J., Greeves, N., Warren, S.	*Organic Chemistry*	Oxford University Press	2012
3.	Oulette, R. J.	*Organic Chemistry: A Brief Introduction*	Prentice Hall	1998

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Oulette, R. J., Rawn, J. D.	*Organic Chemistry: Structure, Mechanism, and Synthesis*	Elsevier	2014
2.	Dewick, P. M.	*Essentials of Organic Chemistry: For Students of Pharmacy, Medicinal Chemistry and Biological Chemistry*	Wiley	2006
3.	Bell, C. E., Taber, D. F., Clark, A. K.	*Organic Chemistry Laboratory: With Qualitative Analysis*	Harcourt College Publishers	2001

Appendix 3 No. 7		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**PHYSICAL CHEMISTRY**			
2.	Code	3FMN192525			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	First year / Second semester	7.	Number of ECTS	6
8.	Professor	Assoc. Prof. Dr.sc. Aleksandar Cvetkovski			
9.	Pre-conditions for course registration	Enrolled in second semester of studies			
10.	**Aims of the study program (competences):** – Acquiring knowledge for the basic physicochemical laws according to which all chemical and biochemical reactions and changes in the state of matter in nature and the living world take place; – Comparative study on the influence of thermodynamic and kinetic factors in change of mass and state of matter in homogeneous and heterogeneous isolated and open systems; – Study of interactions between molecules of a non-covalent nature.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. Introduction to Physical Chemistry; 2. Chemical thermodynamics; 3. Aggregate states of matter; 4. Solubility and formation of solutions and their colligative properties; 5. Colloidal, dispersed systems; 6. Phenomena of boundary surfaces; 7. Molecular interactions that are not of covalent nature; 8. Chemical kinetics; 9. Radiochemistry. *Practical part:* 1. Calculations in thermodynamics; 2. Measurement of heat capacity; 3. Phase equilibria; 4. Electrical conductivity in electrolyte solutions; 5. Electrode potential; 6. Calculation of colligative properties of solutions; 7. Calculations for chemical kinetics; 8. Measurement of first-order reaction rate.				
12.	**Study methods:** Lectures, seminars, exercises, individual assignments, collaborative lectures, methods of group discussions.				
13.	Total amount of time available	6 ECTS x 30 hours = 180 hours (3+2)			
14.	Distribution of tasks	45+30+15+45+45			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	45 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours	
16.	Other types of activities	16.1.	Projects	15 hours	
		16.2.	Individual tasks	45 hours	
		16.3.	Home study – tasks	45 hours	
17.	Evaluation / assessment methods				

<table>
<tr><td rowspan="4"></td><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="2">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="2">Self-evaluation</td></tr>
<tr><td rowspan="6">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="4">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Atkins, P. W., De Paula, J.</td><td>Physical Chemistry for the Life Sciences</td><td>Oxford University Press</td><td>2006</td></tr>
<tr><td>2.</td><td>Sinko, P. J. (Editor)</td><td>Martin’s Physical Pharmacy and Pharmaceutical Sciences (7th Edition)</td><td>Wolters Kluwer India Pvt Ltd</td><td>2020</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="4">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Connors, K. A.</td><td>Thermodynamics of Pharmaceutical Systems: An Introduction for Students of Pharmacy</td><td>Wiley</td><td>2008</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 8</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">HUMAN PHYSIOLOGY AND ANATOMY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN192625</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>First year /
Second semester</td><td>7.</td><td>Number of ECTS</td><td>6</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Assoc. Prof. Dr.sc. Jasminka Chabukovska Radulovska
Adj. Assoc. Prof. Dr.sc. Eli Handjiska</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in second semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
The program aims to provide essential knowledge in human anatomy and physiology, focusing on core information necessary for pharmacy students to study and master the material effectively.
Additionally, students will acquire a foundational understanding of human anatomy and physiology, with an emphasis on the structure and functions of organs and organ systems.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Anatomy:
This part of the course presents human anatomy logically by body region for each major body system:
– Regions: Includes surface and functional anatomy;
– Systems: Includes conceptual and clinical anatomy.
Key topics in this part of the course:
1. Introduction to the human body;
2. Tissue level of organization;
3. Body regions;
4. Integumentary system;
5. Musculoskeletal system (axial and appendicular skeleton, joints, muscles);
6. Cardiovascular system;
7. Nervous system (brain and cranial nerves, spinal cord and spinal nerves, autonomic nervous system);
8. Endocrine system;
9. Immune system;
10. Respiratory system;
11. Digestive system;
12. Urinary system;
13. Reproductive system.
Physiology:
This part of the course covers the fundamental functional organization of the human body, cellular organization, and control of the internal environment.
Key topics in this part of the course:
1. Cellular Physiology: Transport of substances through cell membranes, membrane and action potentials, excitation and contraction of skeletal and smooth muscles;
2. Blood and Immunity: Red blood cells, body’s resistance to infection (leukocytes, granulocytes, monocyte-macrophage system, and inflammation), blood groups, hemostasis, and blood coagulation;</td></tr>
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<table>
<tr><td></td><td colspan="6">3. Cardiovascular system: Physiology of the heart, rhythmic excitation, minute and stroke volume, heart valves and sounds, normal ECG, circulation, and microcirculation, blood flow, and blood pressure;
4. Respiratory system: Pulmonary ventilation, pulmonary circulation, gas exchange principles, oxygen and carbon dioxide transport in blood and tissue fluids, and regulation of respiration;
5. Gastrointestinal physiology: Transport and mixing of food, secretory functions, digestion and absorption in the gastrointestinal tract, and the functions of salivary glands, liver, and pancreas;
6. Renal physiology: Urine production, glomerular filtration, tubular secretion and reabsorption, osmolality regulation, and acid-base balance;
7. Thermoregulation and Metabolism: Regulation of body temperature, hypothermia and hyperthermia;
8. Endocrine system: Pituitary hormones, hypothalamus, thyroid and parathyroid hormones, adrenocortical hormones, pancreatic hormones, and the pineal gland;
9. Reproductive system: Structure of the male and female reproductive systems and the influence of sex hormones in both men and women;
10. Nervous system: Physiology and organization of the nervous system, division, motor functions of the spinal cord, brain stem, and cerebral cortex, spinal reflexes, intellectual brain function, and automatic nervous system;
11. Sensory system: Sensory physiology, including the senses of touch, position, pain, sight, hearing, taste, and smell.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, consultations, independent learning, hands-on practice related to the topic, laboratory exercises, including: demonstrations, individual work, and group participation.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">6 ECTS x 30 hours = 180 hours (3+2)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">45+30+15+45+45</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">45 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td colspan="2">5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td colspan="2">6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td colspan="2">7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td colspan="2">8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td colspan="2">9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td colspan="2">10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="3">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="2">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
</table>

		1.	Guyton, A. C., Hall, J. E.	*Textbook of Medical Physiology*	Elsevier	2016
		2.	Rhoades, R. A., Bell, D. R.	*Medical Physiology*	Wolters Kluwer India Pvt Ltd	2018
		3.	Karthikeyan, K.	*A Textbook of Human Anatomy & Physiology-I, B. Pharmacy (PCI)*	Sia Publishers And Distributors Pvt ltd	2017
		4.	Tortora, G. J., Derrickson, B.	*Principles of Anatomy and Physiology*	Wiley	2014
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Boron, W. F., Boulpaep, E. L.	*Medical Physiology*	Elsevier	2017
		2.	Pocock, G., Richards, C. D., Richards, D. A.	*Human Physiology*	Oxford University Press	2018
		3.	Netter, F. H.	*Netter's Atlas of Human Anatomy*	Elsevier	2022

<table>
<tr><td colspan="2">Appendix 3
No. 9</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">MOLECULAR BIOLOGY AND GENETICS</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN192725</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>First year /
Second semester</td><td>7.</td><td>Number of ECTS</td><td>5</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Full Prof. Dr.sc. Todor Arsov</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in second semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
Understanding the principles of molecular biology and genetics.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. Prokaryotic and eukaryotic cell. Cellular basis of genetic inheritance – cell division, mitosis and meiosis. DNA and chromosomes. Molecular biology of the gene, the central dogma of molecular biology;
2. Human chromosomes, structure and function. Normal human karyotype. Numeric and structural chromosome anomalies;
3. Biomacromolecules. Chemistry, structure and functions of DNA, RNA and proteins. Human genome, genes and alleles, genetic variation in the population;
4. Molecular biology of replication, transcription and translation. Types of genetic variants and the effect of pathogenic genetic variants on protein structure and function. Molecular basis of monogenic conditions;
5. Molecular biology techniques used in cytogenetics and molecular cytogenetics: conventional karyotype, fluorescent in situ hybridization, chromosomal microarray technologies;
6. Molecular biology techniques used in molecular genetics. Extraction of nucleic acids, PCR, RT-PCR, real time PCR, Sanger sequencing, genomics (next-generation sequencing);
7. Genetic contribution to human disease: rare monogenic and common complex polygenic conditions. Monogenic conditions and Mendelian inheritance: autosomal dominant, recessive and X-linked;
8. Violations of Mendelian inheritance in monogenic conditions: mitochondrial inheritance, dynamic mutations, imprinting. Common complex conditions and polygenic inheritance;
9. Genetic testing in the clinic. Diagnostic, predictive and screening genetic tests. Prenatal testing (screening and diagnostic). Types of screening tests;
10. Molecular biology of cancer, cell cycle, DNA repair, proto-oncogenesis and tumor suppressor genes;
11. Pharmacogenomics. Treatment of genetic diseases;
12. New frontiers in genomic medicine, new tests, new treatments. Biotechnology and manufacturing biologic medications. Gene therapy.
Practical part:
1. Construction of a pedigree;
2. Types of biological material in molecular biology (genetic) laboratory. Basic principles of working in molecular biology (genetic) laboratory;
3. Extraction, quantification and visualization of nucleic acids and proteins;
4. Electrophoresis (agarose and polyacrylamide gel);
5. Blotting techniques (Southern, Western, Northern blot);</td></tr>
</table>

<table>
<tr><td></td><td colspan="5">6. Polymerase chain reaction principles, qPCR, real-time PCR, QF-PCR, RT-PCR;
7. Sanger sequencing, analysis of sequences;
8. Conventional karyotype. Analysis of karyograms;
9. Fluorescent in situ hybridization and microarray;
10. Pedigree analysis – types of inheritance. Inheritance of blood groups;
11. Bioinformatics and commonly used molecular biology databases;
12. Bioinformatics and commonly used molecular biology databases.</td></tr>
<tr><td>12.</td><td colspan="5">Study methods:
Interactive lectures, group lectures with discussion and student participation; multimedia support; literature search; E-learning – online molecular biology databases; individual and group consultations; laboratory work; analysis of molecular biology results and pedigree analysis.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="3">5 ECTS x 30 hours = 150 hours (2+2)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="3">30+30+15+10+65</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>10 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>65 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="6">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="4">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Turnpenny, P. D., Ellard, S., Cleaver, R.</td><td>Emery’s Elements of Medical Genetics</td><td>Elsevier</td><td>2021</td></tr>
<tr><td>2.</td><td>Iwasa, J., Marshall, W.</td><td>Karp’s Cell and Molecular Biology</td><td>Wiley</td><td>2016</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="4">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Strachan, T., Read, A. P.</td><td>Human Molecular Genetics</td><td>CRC Press Taylor & Francis</td><td>2018</td></tr>
</table>

Appendix 3 No. 10		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**BIOCHEMISTRY 1**			
2.	Code	3FMN192825			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	First year / Second semester	7.	Number of ECTS	6
8.	Professor	Full Prof. Dr.sc. Danijela Janikjevikj Ivanovska Adj. Ass. Prof. Dr.sc. Marija Atanasova Lazareva			
9.	Pre-conditions for course registration	Enrolled in second semester of studies			
10.	**Aims of the study program (competences):** Students will gain comprehensive knowledge of biological macromolecules (carbohydrates, lipids, proteins, and enzymes), followed by learning their chemical structures and understanding the role of biological macromolecules in the context of living organisms and cellular environment; Gaining basic experience in experimental laboratory work by conducting qualitative and quantitative analyses of the main biomolecules in the human body.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. Basics of biochemistry (definition and tasks, biochemistry as an independent discipline, and as an interdisciplinary science); 2. Water and inorganic salts (metabolism of water and inorganic salts, buffers in the human body and acid-base balance); 3. Amino acids (chemical structure and reactions, classification, biological roles); 4. Peptides (nomenclature, biomedical significance of peptides) and proteins (protein structure, properties and functions, plasma proteins); 5. Carbohydrates: monosaccharides (classification, chemical structures and function); 6. Carbohydrates: oligosaccharides (disaccharides and oligosaccharides) and polysaccharides (homoglycans and heteroglycans); 7. Lipids: triglycerides and fatty acids, phospholipids, glycolipids (chemical structures and function); 8. Lipids: steroids and carotenoids; 9. Enzymes (chemical structure and classification); 10. Mechanism and kinetics of enzymatic reactions, regulatory enzymes; 11. Nucleic acids (structure and function); 12. Water-soluble and fat-soluble vitamins (main sources, chemical structures and biological roles, metabolism, deficiencies and medical usage). *Practical part:* 1. Basic biochemical laboratory principles and safety precautions: basic rules, laboratory equipment and chemicals; 2. Important procedures in biochemical laboratory: filtration, centrifugation, decantation, tissue homogenization and heating; 3. Solutions: preparation and calculations; 4. Examination of the physicochemical properties of proteins: tests based on precipitation reactions of proteins and color reactions of proteins; 5. Reactions of monosaccharides: reduction of monosaccharides, reactions of monosaccharides with bases and mineral acids; 6. Analysis of disaccharides and polysaccharides; 7. Examination of general properties of lipids: solubility, emulsification and hydrolysis;				

	8. Qualitative analysis of lipids: glycerol, fatty acids, cholesterol; 9. Analysis of general properties of enzymes: catalytic action and substrate specificity; 10. Analysis of general properties of enzymes: impact of the temperature and the effectors on the enzymatic activity; 11. The basic principles of nucleic acids; 12. Qualitative reactions of water-soluble and fat-soluble vitamins.				
12.	**Study methods:** Lectures with large group of students, laboratory practical work with small group of students, individual consultations and consultations with small group of students.				
13.	Total amount of time available		6 ECTS x 30 hours = 180 hours (3+2)		
14.	Distribution of tasks		45+30+0+45+60		
15.	Types of learning/teaching activities	15.1.	Lectures – theory	45 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours	
16.	Other types of activities	16.1.	Projects	0 hours	
		16.2.	Individual tasks	45 hours	
		16.3.	Home study – tasks	60 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	
	17.2.	Individual tasks / project (presentation: written and oral)		10 points	
	17.3.	Activity and participation		20 points	
	17.4.	Final exam		30 points	
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)	
			51 – 60 points	6 (six) (E)	
			61 – 70 points	7 (seven) (D)	
			71 – 80 points	8 (eight) (C)	
			81 – 90 points	9 (nine) (B)	
			91 – 100 points	10 (ten) (A)	
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.		
20.	Language of the study program		English		
21.	Quality assurance methods of the teaching process		Self-evaluation		

22. Literature

Mandatory literature

No.	Author	Title	Publisher	Year
1.	Nelson, D. L., Cox, M. M.	*Lehninger Principles of Biochemistry*	W.H. Freeman & Company	2017
2.	Murry, R. K., Granner, D. K., Rodwell, V. W.	*Harper's Biochemistry*	McGraw Hill	2009
3.	Bender, D. A.	*Nutritional Biochemistry of the Vitamins*	Cambridge University Press	2003

Additional literature

No.	Author	Title	Publisher	Year
1.	Vasudevan, D. M., Das, S. K.	*Practical Textbook of Biochemistry for Medical Students (2nd Edition)*	Jaypee Brothers Medical Pub	2013
2.	Mohanty, S., Verma, A.	*Practical Clinical Biochemistry*	Jaypee Brothers Medical Pub	2013

<table>
<tr><td colspan="2">Appendix 3
No. 11</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">BIOCHEMISTRY 2</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN192925</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Second year /
Third semester</td><td>7.</td><td>Number of
ECTS</td><td>6</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Prof. Dr.sc. Tatjana Rushkovska</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in third semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
The main goal of the Biochemistry 2 course is to provide an in-depth study of metabolic processes in the human body, an understanding of their regulation and integration, as well as knowledge about cell signaling.
After defining the concept of metabolism and introducing the basic principles of bioenergetics, all metabolic pathways of carbohydrate metabolism will be studied in detail, as well as the metabolic fate of pyruvate in anaerobic and aerobic conditions. In this part, special attention is given to the mechanisms of regulation and coordination of these metabolic processes.
Furthermore, all chemical reactions of the citric acid cycle, as well as the process of oxidative phosphorylation, are studied in detail.
Next, the catabolism of fatty acids and amino acids, along with the biosynthesis of lipids and compounds derived from amino acids, as well as the biosynthesis and degradation of nucleotides, are thoroughly explored. The metabolism of lipoproteins in blood plasma is also studied in detail.
Lastly, the basic principles of cell signaling, as well as the principles of hormonal regulation and integration of metabolism, are covered.
By successfully mastering the course content provided in this program, students will acquire a high level of knowledge and understanding of cellular metabolic pathways and cycles, with a particular emphasis on the mechanisms for their regulation and integration, both at the cellular level and the whole organism.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
1. Metabolism and bioenergetics: Concept of metabolism and classification (Catabolism; Anabolism; Organization of the metabolic pathways); Principles of bioenergetics (Biological energy transformations obey the laws of thermodynamics; Exergonic and endergonic reactions, free energy; Principle of additivity of changes in standard free energy; Energy supply from adenosine triphosphate ‘ATP’ by group transfers).
In this chapter, students will be introduced to the Biochemistry 2 course by defining the concept of metabolism and exploring the basic principles of bioenergetics.
2. Glycolysis, gluconeogenesis, and pentose-phosphate pathway: Digestion and absorption of carbohydrates; Glycolysis – definition, cellular localization, and reactions (Phases of glycolysis; ATP yield from glycolysis; Metabolic transformations of pyruvate under anaerobic and aerobic conditions; Warburg effect); Gluconeogenesis – definition, cellular localization, and reactions (Bypassing irreversible reactions of glycolysis; Energy consumption of gluconeogenesis; Glucogenic compounds; Cori cycle); Pentose-phosphate pathway – definition, cellular localization, and reactions (Roles of the pentose-phosphate pathway; Phases of pentose-phosphate pathway; Glucose 6-phosphate dehydrogenase deficiency).
In this chapter, students will study in detail all the reactions of the metabolic pathways of glycolysis, gluconeogenesis, and the pentose-phosphate pathway, as well as the enzymes that</td></tr>
</table>

	catalyze each reaction. Additionally, students will learn about the biological role of each of these metabolic pathways. 3. Glycogen metabolism: Glycogenolysis – definition, cellular localization, and reactions; Glycogenesis – definition, cellular localization, and reactions (Glycogenin); Glycogen storage diseases. In this chapter, students will study in detail all the reactions of the metabolic pathways of glycogenolysis and glycogenesis, as well as the enzymes that catalyze each reaction. Additionally, students will learn about the biological role of these metabolic pathways. 4. Principles of metabolic regulation: Coordinated regulation of glycolysis and gluconeogenesis (Regulation of hexokinase in the liver and skeletal muscles; Complex allosteric regulation of phosphofructokinase-1; Fructose 2,6-bisphosphate as a regulator of glycolysis and gluconeogenesis; Allosteric regulation of pyruvate kinase; Xylulose 5-phosphate as a key regulator of carbohydrate and lipid metabolism); Coordinated regulation of glycogenolysis and glycogenesis (Hormonal and allosteric regulation of glycogen phosphorylase; Regulation of glycogen synthase by phosphorylation and dephosphorylation). By mastering the content of this chapter, students will gain an in-depth understanding of the regulation and coordination of metabolic pathways, biological processes essential for the survival of living organisms. 5. Citric acid cycle – definition, cellular localization, and reactions: Oxidative decarboxylation of pyruvate (Pyruvate dehydrogenase complex); Reactions of the citric acid cycle; ATP yield from the citric acid cycle; Regulation of the citric acid cycle. In this chapter, students will study in detail all the reactions of the citric acid cycle, the enzymes that catalyze each reaction, as well as all the products of the cycle, while also recognizing its central role in cellular metabolism. 6. Oxidative phosphorylation – definition, cellular localization, and detailed description of the process: Components of the respiratory chain; Chemiosmotic theory, proton-motive force; Synthesis of ATP (Rotational catalysis); ATP yield from the complete oxidation of glucose; Regulation of oxidative phosphorylation; Heat production in brown adipose tissue; Production of free radicals at the level of the respiratory chain and antioxidant protection systems. In this chapter, students will study in detail the process of oxidative phosphorylation as the final stage of catabolism in aerobic organisms, as well as associated process: heat production in brown adipose tissue and the production of free radicals in mitochondria. 7. Fatty acid catabolism: Digestion and absorption of lipids; Mobilization of stored triglycerides; Beta-oxidation of saturated fatty acids with an even number of carbon atoms, in the mitochondria; ATP yield from the complete oxidation of palmitic acid; Beta-oxidation of unsaturated fatty acids; Beta-oxidation of fatty acids with an odd number of carbon atoms; Other types of fatty acid oxidation (Beta-oxidation in peroxisomes; Omega-oxidation in the endoplasmic reticulum; Alpha-oxidation in peroxisomes); Ketogenesis. In this chapter, students will study in detail all the reactions of the metabolic pathways of beta-oxidation of fatty acids and ketogenesis, the enzymes that catalyze each reaction, as well as the energy contribution from the complete oxidation of palmitic acid, a saturated fatty acid with an even number of carbon atoms. Additionally, students will learn about the biological role of these metabolic pathways. 8. Amino acid oxidation and the urea cycle: Digestion and absorption of proteins; Transamination; Oxidative deamination of glutamate; Glutamine; Glucose-alanine cycle; Urea cycle – definition, cellular localization, and reactions; Pathways of amino acid degradation (Glucogenic and ketogenic amino acids; Some human diseases resulting from genetic defects of enzymes involved in amino acid catabolism – phenylketonuria, alkaptonuria, maple syrup urine disease). In this chapter, students will gain a high level of knowledge and understanding of amino acid catabolism, its complexity, and its connections to other metabolic pathways and processes in

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<tr><td></td><td colspan="4">cellular metabolism. Furthermore, students will study in detail all the reactions of the urea cycle and acquire knowledge about the biological role of this cycle.
9. Lipid biosynthesis: Fatty acid biosynthesis (Palmitic acid biosynthesis; Elongation and desaturation of fatty acids; Regulation of fatty acid biosynthesis and beta-oxidation); Eicosanoid biosynthesis; Triglyceride biosynthesis; Biosynthesis of membrane phospholipids; Cholesterol biosynthesis and its derivatives – bile acids, steroid hormones, vitamin D (Regulation of cholesterol biosynthesis).
By mastering the content of this chapter, students will acquire in-depth knowledge of the biosynthetic pathways of lipids, a highly heterogeneous class of biomolecules with storage, structural, and signaling functions.
10. Structure and metabolism of plasma lipoproteins: Metabolism of chylomicrons; Metabolism of VLDL particles; Metabolism of LDL particles; Metabolism of HDL particles.
By mastering the content of this chapter, students will gain knowledge of the structure and metabolism of circulating lipoprotein particles and their roles in lipid transport and metabolism.
11. Biosynthesis of amino acids and nucleotides: Biosynthesis of molecules derived from amino acids (Biosynthesis of porphyrins, bilirubin; Biosynthesis of creatine; Biosynthesis of glutathione; Biological amines, products of amino acid decarboxylation: Dopamine, Norepinephrine, Epinephrine, Gamma-aminobutyric acid ‘GABA’, Histamine, Serotonin; Biosynthesis of nitric oxide); Biosynthesis (*de novo* and *salvage*) and degradation of nucleotides (Purine nucleotide biosynthesis; Pyrimidine nucleotide biosynthesis; Ribonucleotides as precursors of deoxyribonucleotides; Degradation of purine and pyrimidine nucleotides to uric acid and urea, respectively).
By mastering the content of this chapter, students will acquire general knowledge about the biosynthesis of amino acids. Additionally, they will become familiar with the biosynthesis of important biomolecules derived from amino acids, as well as the biosynthesis and degradation of nucleotides.
12. Biosignaling: Gated ion channels (Ligand-gated ion channels; Voltage-gated ion channels); Receptor enzymes (Receptor enzymes with tyrosine kinase activity; Receptor enzymes with guanylyl cyclase activity); G-protein coupled receptors (Action through adenylyl cyclase; Action through phospholipase C); Sensory transduction; Regulation of transcription by steroid hormones; Regulation of the cell cycle by protein kinases; Oncogenes, tumor suppressor genes, and apoptosis.
By mastering the content of this chapter, students will gain basic knowledge about the mechanisms of cell signaling that are important for cellular metabolism and functions.
13. Hormonal regulation and integration of metabolism: Tissue-specific metabolism – liver, adipose tissue, skeletal muscles, brain, blood; Hormonal regulation of energy metabolism.
By mastering the content of this chapter, students will gain a comprehensive understanding of how individual metabolic pathways integrate across entire organism. This knowledge will consolidate what they have learned in Biochemistry 1 and Biochemistry 2, providing a strong foundation for future courses.</td></tr>
<tr><td>12.</td><td colspan="4">Study methods:
Theoretical lectures, classroom practice, video presentations, project tasks.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="2">6 ECTS x 30 hours = 180 hours (3+2)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="2">45+30+30+30+45</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>30 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>30 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>30 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>45 hours</td></tr>
<tr><td>17.</td><td colspan="4">Evaluation / assessment methods</td></tr>
</table>

<table>
<tr><td rowspan="4"></td><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="2">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="2">Self-evaluation</td></tr>
<tr><td rowspan="6">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="4">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Nelson, D. L., Cox, M. M.</td><td>Lehninger Principles of Biochemistry (5th Edition)</td><td>W.H. Freeman & Company</td><td>2008</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="4">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td colspan="4">Relevant scientific papers (primary literature)</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 12</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">PHARMACEUTICAL BOTANY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN193025</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Second year /
Third semester</td><td>7.</td><td>Number of
ECTS</td><td>6</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Assoc. Prof. Dr.sc. Viktorija Maksimova</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in third semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
The main purpose of this course is acquiring basic knowledge in the fields of cytology, histology, and organography of plants, and plant systematics with special emphasis on medicinal plants, for further application of this knowledge into proper identification of medicinal plants.
Training students for the proper preparation of native specimens, their microscopy, and correct identification of plant species would provide special skills for students in their pharmaceutical career, especially in herbal medicines.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
Theoretical lectures are going to comprise an introduction to botany, plant cell specifics; plant tissues, meristematic and permanent tissues (covering, parenchymal, mechanical, conductive, glandular); plant organs (anatomy and morphology), primary and secondary structure of roots and stems, morphology of leaves; anatomy of the flower, flowering, pollination, fertilization, fruit and seed formation. Basic physiological processes in plants (transpiration, photosynthesis, respiration) will enlarge the knowledge of students in further synthesis of secondary metabolites.
Systematic, morphological, anatomical, study of medicinal and poisonous plants would be processed by studying plant systematics according to Linnaeus with an emphasis to plants known for their biological/pharmacological action: Systematics of lower plants, Thallophyta – algae (Algae); Systematics of lower plants – fungi (Fungi); Systematics of lower plants – lichens (Lichenes). Systematics of higher plants, Cormophyta – gymnosperms (Gymnospermae); Systematics of angiosperms (Angiospermae): monocotyledonous plants (Monocotyledones: Liliales, Iridales, Orchidales, Poales, Arales); Systematics of angiosperm dicotyledonous plants: taxa, morphology, and application (Dicotyledones: Magnoliales, Aristolohiales, Ranunculales, Papaverales, Fagales, Urticales, Caryophyllales, Polygonales, Theales, Violales, Cucurbitales, Capparales, Salicales, Ericales, Primulales, Malvales, Euphorbiales); Systematics of dicotyledonous plants: taxa, morphology, and application (Dicotyledones: Rosales, Fabales, Myrtales, Rutales, Sapindales, Geraniales, Cornales, Rhamnales, Santalales, Oleales, Gentianales, Dipsacales, Boraginales, Scrophulariales, Lamiales, Asterales).
Practical part:
Practical engagement of students in discovering structure of plant cells and cellular organelles; cell division, stages of mitosis and meiosis; plant tissues (meristematic and permanent tissues), root and stem meristem, and permanent covering tissues; plant tissues (parenchymal and mechanical tissues), characteristic elements for botanical identification; plant tissues (conductive, secretory, and excretory tissues). Systematics and phylogeny of lower plants (algae and their representative specimens). Systematics and phylogeny of fungi and lichens, their representative specimens. Systematics and phylogeny of higher plants, monocotyledons and their representative specimens. Systematics of gymnosperms, their representative</td></tr>
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<tr><td></td><td colspan="6">specimens. Systematics of angiosperm dicotyledonous plants, representative specimens of medicinal plants.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, theoretical and practical laboratory exercises, consultations, group and individual work (project assignments with oral presentations). Three days fieldwork seminars aimed at recognizing and identifying medicinal plants from national flora. Individual work for preparation of herbarium.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">6 ECTS x 30 hours = 180 hours (2+3)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">30+45+15+30+60</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>30 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>60 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
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<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Shipunov, A.</td><td>Introduction to botany</td><td>Minot State University, North Dakota</td><td>2021</td></tr>
<tr><td>2.</td><td>Youngken, H. W.</td><td>Pharmaceutical Botany</td><td>Kessinger Publishing</td><td>2019</td></tr>
<tr><td>3.</td><td>Upton, R. et al. (Editors)</td><td>American Herbal Pharmacopoeia, Botanical Pharmacognosy</td><td>CRC Press Taylor & Francis</td><td>2011</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Mauseth, J. D.</td><td>Botany: An Introduction to Plant Biology</td><td>Jones & Bartlett Learning</td><td>2019</td></tr>
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<table>
<tr><td colspan="2">Appendix 3
No. 13</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">BIOORGANIC CHEMISTRY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN193125</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Second year /
Third semester</td><td>7.</td><td>Number of
ECTS</td><td>7</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Ass. Prof. Dr.sc. Marija Arev</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in third semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
The primary objective of this curriculum is to enhance and deepen students' understanding of organic chemistry by introducing advanced topics specifically related to biologically and pharmacologically active substances. This course will provide an exploration of the structures, physical properties, chemical reactions, and synthesis methods of these compounds. This curriculum is designed to prepare students for more specialized fields such as pharmaceutical chemistry and analytical chemistry focused on drugs. In addition to theoretical knowledge, the curriculum will emphasize practical applications, enabling students to engage in laboratory experiments that demonstrate the principles of organic chemistry.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. Ethers and epoxides: definition, nomenclature, structure, properties, synthesis and reactions;
2. Thiols and sulfides: structure, properties, reactions and preparation;
3. Carboxylic acids and nitriles: chemistry of nitriles, structure and properties of carboxylic acids, nomenclature, synthesis and reactions;
4. Derivatives of carboxylic acids: mechanisms of nucleophilic acyl substitution reactions, chemistry and structure of esters, amides, acid halides and anhydrides; nomenclature, synthesis and chemical reactivity properties of derivatives of carboxylic acids:
5. Mechanisms of carbonyl alpha substitutional reactions and carbonyl condensation reactions: keto-enol tautomerism, acidity of alpha hydrogen in carbonyl compound and formation of enolates and enolate ions;
6. Amines and nitro compounds: definition, nomenclature, structure, properties, synthesis and reactions;
7. Biomolecules - Proteins: Amino acids - definition and importance; classification of amino acids; isoelectric point; titration curves and ionic equilibrium; Henderson–Hasselbalch equation; synthesis of α-amino acids; Peptides - definition and nomenclature; structure and properties of the peptide bond; determination of the peptide structure; laboratory synthesis of peptides; Proteins – definition and biological importance; classification of proteins; levels of structural organization of proteins – primary, secondary, tertiary and quaternary structure; denaturation of proteins; structure and properties of some important proteins;
8. Biomolecules – Carbohydrates: definition, occurrence and function of carbohydrates; classification of carbohydrates; stereochemistry of carbohydrates; Fischer projection formulas; cyclic structures of carbohydrates; anomers and mutarotation; chemical reactions of monosaccharides; Disaccharides - type of joining and some important disaccharides; polysaccharides – classification and some important polysaccharides; pharmacologically important derivatives of carbohydrates;</td></tr>
</table>

<table>
<tr><td></td><td colspan="4">9. Biomolecules – Lipids: definition, function and importance of lipids; classification fatty acids, waxes; triglycerides; soaps; phospholipids; prostaglandins; terpenoids; steroids - natural and synthetic;
10. Heterocyclic compounds: definition and importance; aromaticity and aromatic and nonaromatic heterocyclic compounds; five membered aromatic heterocyclic rings – preparation, structure, chemical reactions; examples of pharmaceutically important five membered rings with one and two heteroatoms; six membered rings – structure, properties, chemical reactions; examples of pharmaceutically important six membered rings with one and two heteroatoms; six membered rings and with fused aromatic rings;
11. Nucleic acids: definition of nucleoside, nucleotide and nucleic acid, consistency and nomenclature; chemical bonds in nucleic acids; levels of structural organization of DNA and RNA; heredity – replication, transcription, translation, PCR technics;
12. Metabolic pathways: Catabolism of lipids, proteins, and carbohydrates; Krebs cycle (Citric acid cycle); Anabolism of fatty acids, amino acids and glucose.
Practical part:
1. Introduction to laboratory work: equipment, apparatus, safety;
2. Synthesis, isolation and purification of organic compounds; calculation of percent reaction yield;
3. Chromatographic separation of organic compounds – thin-layer chromatography;
4. Column chromatography – size exclusion chromatography;
5. Titration of amino acids (glycine);
6. Construction of the titration curve;
7. Enzymes; Catalase;
8. Determination of citric acid in bubble gum by titration;
9. Synthesis of aspirin;
10. Purification of aspirin by recrystallization and calculation of percent reaction yield;
11. Synthesis of acetanilide;
12. Purification of acetanilide and calculation of percent reaction yield.</td></tr>
<tr><td>12.</td><td colspan="4">Study methods:
Lectures, exercises, theoretical and practical activities, seminars, consultation and individual learning.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="2">7 ECTS x 30 hours = 210 hours (3+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="2">45+45+15+25+80</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>45 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>25 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>80 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="4">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="2">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="2">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="2">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="2">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="2">English</td></tr>
</table>

<table>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="12">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="5">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>McMurry, J. E.</td><td>Organic Chemistry (6th Edition)</td><td>Brooks Cole</td><td>2003</td></tr>
<tr><td>2.</td><td>Vollhardt, P., Schore, N.</td><td>Organic Chemistry: Structure and Function</td><td>Macmillan Learning</td><td>2018</td></tr>
<tr><td>3.</td><td>Wade, L., Simek, J. W.</td><td>Organic Chemistry</td><td>Pearson</td><td>2016</td></tr>
<tr><td rowspan="5">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Soderberg, T.</td><td>Organic Chemistry with a Biological Emphasis</td><td>University of Minnesota Morris Digital Well</td><td>2016</td></tr>
<tr><td>2.</td><td>Clayden, J., Greeves, N., Warren, S.</td><td>Organic Chemistry</td><td>OUP Oxford</td><td>2012</td></tr>
<tr><td>3.</td><td>Carey, F. A., Sundberg, R. J.</td><td>Advanced Organic Chemistry: Structure and Mechanisms</td><td>Springer</td><td>2017</td></tr>
</table>

Appendix 3 No. 14		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**ANALYTICAL CHEMISTRY 1**			
2.	Code	3FMN193225			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Second year / Third semester	7.	Number of ECTS	6
8.	Professor	Full Prof. Dr.sc. Rubin Gulaboski Ass. Prof. Dr.sc. Milkica Arsova			
9.	Pre-conditions for course registration	Enrolled in third semester of studies			
10.	**Aims of the study program (competences):** Upon completion of this course, the students will be able to: – understand the basic theoretical principles of analytical chemistry; – understand the properties of the solutions, and knowing how to prepare and dilute solutions; – account the concept of pH and applying it for measuring pH of strong acids and strong bases; – understand the equilibrium processes and applying the principle of Le Chatelier; – understand the concept of pH and applying it for measuring pH of drugs that are weak bases or weak acids; – understand the equilibria related to creation of sparingly soluble salts and applying the principles of Le Chatelier to predict the precipitation of various drugs; – understand the principles of covalent coordination bonding and knowing to read various complex substances in which coordinate bonds exist; – understand the principles of equilibria in complexation reactions of various drugs; – be familiar with basic experimental methodology of voltammetry in the area of drug analysis; – understand the principles of equilibria by drug-drug interactions; – solve theoretical exercises related to all equilibria in which given drug can be involved; – apply commercially available tools to solve mathematical problems in analytical chemistry related to equilibria of various drugs.				
11.	**Content of the study program (applies both for theoretical and practical part):** – Introduction to analytical chemistry – Concept of amount of substance, mole, molar mass; – Solutions; classification of solutions; properties of solutions; – Expressing the quantitative content in solutions; – Acids and bases, concept of strong acids (monoprotic and polyprotic) and strong bases. Concepts of measuring pH in these systems; – Chemical equilibria applied to various chemical reactions; – Principle of Le Chatelier and practical aspects of this law applied in various drugs; – Equilibria by weak acid (monoprotic and polyprotic) and weak bases and applying the concept of pH by these systems; – Solubility product and equilibria in systems of sparingly soluble salts; – Complexes with coordinative chemical bonds; basics of coordination chemistry; nomenclature of coordinative complexes; – Equilibria in the reaction of complexes with coordinative chemical bonds and application to the complexes of some relevant drugs;				

<table>
<tr><td></td><td colspan="5">– Concept of chemical equilibria in drug-drug interactions and applying the Principle of Le Chatelier;
– Exploring analytical tools (Excel, MATHCAD, MatLab) for solving theoretical problems in analytical chemistry.</td></tr>
<tr><td>12.</td><td colspan="5">Study methods:
All contents of the subject Analytical chemistry 1 will be presented to the students in several manners of in-person classes:
– All theoretical lectures will be held to the whole group of students, where the students will be introduced to the fundamental contents of the subject. At the beginning of each lecture, the main objectives of that lecture will be clearly stated. At the end of each lecture, exercises and problems relevant the contents of particular lecture will be presented. The lectures will be held using the blackboard, power point presentations and relevant audio-visual materials;
– Regular seminar works will be held, in which the students will focus on solving numerical problems and practical problems related to the material elaborated in the course;
– Tutorial platform will be created in order to make a discussion link between the students with the teachers, in order to solve particular problems and to answer questions related to the course;
– Laboratory practices apply to this course with 3-hour sessions each week. Upon ending each practical session, a short seminar will be held in order to discuss of the results obtained by the students;
– In addition, via the self-study activities, students should be given practical problems to be solved, as well as quizzes related to different topics of the subject proposed by the teachers. These segments will be evaluated as independent work activities of each student.
The general objective of all activities previsedin the Analytical chemistry 1 course is that the students get knowledge and experience on how to solve theoretically a given problem and to apply it in the areas of drug analysis, drug activity, drug inactivation and drug-drug interactions all related to different chemical equilibria.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="3">6 ECTS x 30 hours = 180 hours (2+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="3">30+45+30+30+45</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>30 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>30 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>45 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="3">English</td></tr>
</table>

<table>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="8">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Skoog, D. A., West, D. M., Holler, F. J., Crouch, S. R.</td><td>Analytical Chemistry (9th Edition)</td><td>Brooks/Cole Cengage, UK</td><td>2014</td></tr>
<tr><td>2.</td><td>Miller, J., Miller, J. N. Y., Jane, C.</td><td>Statistics and Chemometrics for Analytical Chemistry</td><td>Prentice Hall</td><td>2010</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Gulaboski, R.</td><td>Analytical Chemistry (personal authorized lectures available on www.rubingulaboski.synthasite.com and on Repository of Goce Delcev University)</td><td>Goce Delcev University, Stip</td><td>2021</td></tr>
</table>

Appendix 3 No. 15		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**MICROBIOLOGY AND PARASITOLOGY**			
2.	Code	3FMN193325			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Second year / Third semester	7.	Number of ECTS	5
8.	Professor	Assoc. Prof. Dr.sc. Golubinka Boshevska Ass. Prof. Dr.sc. Gorica Popova			
9.	Pre-conditions for course registration	Enrolled in third semester of studies			
10.	**Aims of the study program (competences):** The main goal of the course is for students to get to know and acquire solid theoretical and practical knowledge in the field of microbiology.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* In the general part, students are introduced to: the historical development of microbiology as a science, the meaning of microorganisms, classification, taxonomic categories, nomenclature, size, shape and arrangement of bacteria; the construction of bacterial cells, the conditions for their growth and reproduction, morphology of bacterial colonies and some characteristic biochemical reactions. In the section in which the genetics of bacteria will be discussed, the topics of phenotypic and genotypic variations of bacteria as well as gene transfer will be covered. Pathogenicity and virulence in microorganisms, non-specific and specific defense (immunity) in humans, immunotherapy and immunoprophylaxis, antibiotics and chemotherapeutics will also be covered. In the special section, students are introduced to the most important bacteria, viruses, fungi and parasites: aerobic and anaerobic Gram-positive and negative cocci, the most important Gram-negative bacilli, Gram-positive bacilli (sporogenous and non-sporogenous), spiral bacteria, rickettsia, mycobacteria, chlamydia; morphology, structure, classification and reproduction of viruses, significance of viral infections, most important DNA and RNA viruses; morphology, structure, classification and reproduction of fungi, the most important causes of superficial and systemic mycoses; morphology, structure, classification and significance of certain parasites. *Practical part:* Principles of safety at work in a microbiological laboratory; Taking, packing and sending material for microbiological examination; Sterilization and disinfection; Microscope and microscopic examinations of microorganisms (light microscope, fluorescence microscope, electron microscope); Staining of microorganisms (Gram, Ziehl-Neelsen); Nutrient media and cultivation of microorganisms; Identification of bacteria (classical biochemical reactions, automatic identification systems); Examination of the sensitivity of bacteria to chemotherapeutic agents; Classic serological reactions, rapid tests, immunoenzymatic methods; Blood cultures; Microbiological diagnosis of wound infections, respiratory infections, genito-urinary and sexually transmitted infections, infections with entero-pathogenic bacteria; Methods for microbiological diagnosis of viral, fungal and parasitic diseases, important for human medicine.				
12.	**Study methods:**				
13.	Total amount of time available	5 ECTS x 30 hours = 150 hours (2+2)			
14.	Distribution of tasks	30+30+0+30+60			
15.		15.1.	Lectures – theory	30 hours	

<table>
<tr><td></td><td colspan="2">Types of learning/teaching activities</td><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td>30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td>0 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td>30 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td>60 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="4">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="4">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="6">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Brooks, G. F., Carroll, K. C., Butel, J. S., Morse, S. A., Mietzner, T. A.</td><td>Jawetz, Melnick & Adelberg’s Medical Microbiology (26th Edition)</td><td>McGraw Hill</td><td>2013</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Murray, P. R., Rosental, K. S., Pfaller, M. A.</td><td>Medical Microbiology (8th Edition)</td><td>Elsevier</td><td>2016</td></tr>
</table>

Appendix 3 No. 16			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**INSTRUMENTAL PHARMACEUTICAL ANALYSIS**			
2.	Code		3FMN193425			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Second year / Fourth semester	7.	Number of ECTS	6
8.	Professor		Full Prof. Dr.sc. Zorica Arsova Sarafinovska Ass. Prof. Dr.sc. Milkica Arsova			
9.	Pre-conditions for course registration		Enrolled in fourth semester of studies			
10.	**Aims of the study program (competences):** The course aims to provide comprehensive knowledge of modern instrumental methods and techniques used for qualitative and quantitative analysis across various fields of pharmacy. Upon successful completion, students will have a solid understanding of the principles behind these instrumental methods, commonly applied in pharmaceutical analyses, along with skills in statistical calculation and result evaluation.					
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* Sampling and analysis; Statistical processing and data analysis; Spectroscopic techniques and their application in pharmaceutical analyses; Molecular spectrometry: ultraviolet/visible spectrometry; Fluorescence spectrometry; Infrared spectrometry; Nuclear magnetic resonance (NMR) spectroscopy; Mass spectrometry; Atomic spectrometry: atomic absorption spectrometry; atomic emission spectrometry; Separation techniques and their application in pharmaceutical analyses: gas chromatography; liquid chromatography; thin-layer chromatography; electrophoresis; Electroanalytical techniques (potentiometry, voltammetry) and their application in pharmaceutical analyses; Statistical processing and evaluation of data from analytical tests. *Practical part:* Corresponding to the lecture topics.					
12.	**Study methods:** Theoretical part: Interactive teaching, multimedia instruction, e-learning, individual consultations with students and group consultations; Practical part: Laboratory practices in small groups of 10 students.					
13.	Total amount of time available		6 ECTS x 30 hours = 180 hours (2+3)			
14.	Distribution of tasks		30+45+0+45+60			
15.	Types of learning/teaching activities	15.1.	Lectures – theory		30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork		45 hours	
16.	Other types of activities	16.1.	Projects		0 hours	
		16.2.	Individual tasks		45 hours	
		16.3.	Home study – tasks		60 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			40 points	
	17.2.	Individual tasks / project (presentation: written and oral)			10 points	
	17.3.	Activity and participation			20 points	
	17.4.	Final exam			30 points	
18.	Assessment criteria (points / grade)		Up to 50 points		5 (five) (F)	
			51 – 60 points		6 (six) (E)	

			61 – 70 points		7 (seven) (D)
			71 – 80 points		8 (eight) (C)
			81 – 90 points		9 (nine) (B)
			91 – 100 points		10 (ten) (A)
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.		
20.	Language of the study program		English		
21.	Quality assurance methods of the teaching process		Self-evaluation		
22.	Literature				
	22.1.	Mandatory literature			
		No. Author	Title	Publisher	Year
		1. Gulaboski, R., Maksimova, V., Ivanova Petropulos, V.	*Instrumental pharmaceutical analyses (textbook)*	Goce Delcev University, Stip	2019
		2. Skoog, D. A., Holler, F. J., Nieman, T. A.	*Principles of Instrumental Analysis*	Saunders College Publishing	2018
	22.2.	Additional literature			
		No. Author	Title	Publisher	Year
		1.			

<table>
<tr><td colspan="2">Appendix 3
No. 17</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="5">PATHOPHYSIOLOGY WITH PATHOLOGY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="5">3FMN193525</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td colspan="2">Second year /
Fourth semester</td><td>7.</td><td>Number of ECTS</td><td>5</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="5">Adj. Assoc. Prof. Dr.sc. Djengis Jashar
Adj. Ass. Prof. Dr.sc. Tanja Angjusheva</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="5">Enrolled in fourth semester of studies</td></tr>
<tr><td>10.</td><td colspan="6">Aims of the study program (competences):
– Introduction to the etiology, pathogenesis and morphological changes in the cells and tissues of the organism under the influence of pathological agents and their diagnostics using various techniques;
– Introduction to the basic cellular and tissue response to damage caused by various causes;
– Introduction to the main mechanisms of acute and chronic inflammation, tissue regeneration and repair;
– Learning the basic concepts of hemodynamic disorders, blood disorders, and the immunopathology;
– Introduction to the main diseases of connective tissue, aka autoimmune disorders, as well as amyloidosis;
– Introduction to the main concept of neoplastic growth, staging of the tumors, tumor types and molecular basis of carcinogenesis;
– Introduction to organ specific diseases by drug abuse and remedies;
– Introduction to general disorders of function and pathophysiological processes of the organism.</td></tr>
<tr><td>11.</td><td colspan="6">Content of the study program (applies both for theoretical and practical part):
Pathophysiology (theoretical part):
Disorders of energy metabolism and metabolism of essential nutrients; Hypoxia; Disturbances in water and electrolyte flow; Pathophysiology of the immune system; Inflammation, sepsis; Mechanisms of shock; Pathophysiology of the cardiovascular system; Pathophysiology of the respiratory system; Pathophysiology of the hepato-gastrointestinal system; Pathophysiology of the urinary system; Acid-base balance disorder.
Pathology (theoretical part):
General pathology: cellular damage, adaptations and death; Acute and chronic inflammations; Specific inflammations; Regeneration and repair of tissues; Hemodynamic disorders; Immunopathology; Neoplasia; Tissue damages caused by drugs.
Practical part:
Practical teaching will be associated with the theoretical lectures.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Presentation of theoretical lectures, interactive presentations, practice.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">5 ECTS x 30 hours = 150 hours (2+2)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">30+30+10+30+50</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td colspan="2">Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td colspan="2">10 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td colspan="2">30 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td colspan="2">50 hours</td></tr>
</table>

<table>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="2">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="2">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="5">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Kumar, V., Abbas, A. K., Aster, J. C. (Editors)</td><td>Robbins & Cotran Pathologic Basis of Disease (10th Edition)</td><td>Elsevier</td><td>2018</td></tr>
<tr><td>2.</td><td>Klatt, E. K. (Editor)</td><td>Robbins & Cortan Atlas of Pathology (4th Edition)</td><td>Elsevier</td><td>2020</td></tr>
<tr><td>3.</td><td>McCorry, L. K., Zdanowicz, M. M.</td><td>Essentials of human physiology and pathophysiology for pharmacy and allied health</td><td>Routledge</td><td>2019</td></tr>
<tr><td>4.</td><td>Huether, S. E., McCance, K. L.</td><td>Understanding pathophysiology</td><td>Elsevier</td><td>2017</td></tr>
<tr><td rowspan="4">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Kumar, V., Abbas, A. K., Aster, J. C. (Editors)</td><td>Robbins Basic Pathology (10th Edition)</td><td>Elsevier</td><td>2017</td></tr>
<tr><td>2.</td><td>Harold, J., Bryuere, J. R.</td><td>100 Cases in pathophysiology</td><td>Lippincott Williams & Wilkins</td><td>2009</td></tr>
<tr><td>3.</td><td colspan="4">https://www.mbfbioscience.com/products/biolucida-medical-education</td></tr>
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<table>
<tr><td colspan="2">Appendix 3
No. 18</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">ANALYTICAL CHEMISTRY 2</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN193625</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Second year /
Fourth semester</td><td>7.</td><td>Number of
ECTS</td><td>6</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Full Prof. Dr.sc. Rubin Gulaboski
Ass. Prof. Dr.sc. Milkica Arsova</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in fourth semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
Upon completion of this course, the students will be able to:
– give examples of typical issues of analytical chemical nature in the development and analytical control of pharmaceuticals;
– account for the validation procedure of an analytical method and will be able to use the most common concepts that are included in the validation protocol; errors in chemical analyses;
– describe the parts and operating manner of an electrochemical cell and account for its application for pH determination and for the determination of drugs having acidic or alkaline properties;
– describe the conductometric device and account for its application for conductometric determination of ionized drugs;
– use the principle for the titrimetric quantitative analysis of pharmaceutical substances;
– account for quantitative analysis of drug molecules with potentiometric techniques;
– account for quantitative analysis of drug molecules with conductometric techniques;
– account for quantitative analysis of drug molecules with paper chromatographic techniques;
– get familiar with basic experimental methodology of voltammetry in the area of drug analysis.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
– Introduction to Qualitative analytical chemistry; sample and sample preparation; classification of separation methods;
– Qualitative analytical chemistry: Qualitative analysis of inorganic cations;
– Qualitative analytical chemistry: Qualitative analysis of inorganic anions;
– Introduction to Quantitative analytical chemistry;
– Chemometrics – Statistical data treatment. Variance and mean comparison. Protocol of calibration. Statistical parameters relevant to analytical chemistry;
– Introduction to the methods of titrations in quantitative analytical chemistry;
– Acid-base titrations; redox titrations; titrations with precipitations; complexometric titrations;
– Basic principles of Potentiometry;
– Potentiometric titrations;
– Basic principle of conductometry;
– Conductometric titrations;
– Basics of voltametric techniques in drug analysis;
– Application of voltammetry for quantitative analysis of drugs;
– Application of voltammetry for studying of drug-drug interactions;
– Basics of paper chromatography and its application for drug quantification.</td></tr>
</table>

<table>
<tr><td>12.</td><td colspan="6">Study methods:
All contents of the subject Analytical chemistry 2 will be presented to the students in several manners of in-person classes:
– All theoretical lectures will be held to the whole group of students, where the students will be introduced to the fundamental contents of the subject. At the beginning of each lecture, the main objectives of that lecture will be clearly stated. At the end of each lecture, exercises and problems relevant the contents of particular lecture will be presented. The lectures will be held using the blackboard, power point presentations and relevant audio-visual materials;
– Regular seminar works will be held, in which the students will focus on solving numerical problems and practical problems related to the material elaborated in the course;
– Tutorial platform will be created in order to make a discussion link between the students with the teachers, in order to solve particular problems and to answer questions related to the course;
– Laboratory practices apply to this course with 3-hour sessions each week. Upon ending each practical session, a short seminar will be held in order to discuss of the results obtained by the students;
– In addition, via the self-study activities, students should be given practical problems to be solved, as well as quizzes related to different topics of the subject proposed by the teachers. These segments will be evaluated as independent work activities of each student.
The general objective of all activities previsedin the Analytical chemistry 2 course is that the students get knowledge and experience on how to apply analytical methods and to solve problems in the areas such as chemical analysis or pharmaceutical analysis.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">6 ECTS x 30 hours = 180 hours (2+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">30+45+30+30+45</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">30 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">30 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td colspan="2">5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td colspan="2">6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td colspan="2">7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td colspan="2">8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td colspan="2">9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td colspan="2">10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="3">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="2">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
</table>

		1.	Skoog, D. A., West, D. M., Holler, F. J., Crouch, S. R.	*Analytical Chemistry (9th Edition)*	Brooks/Cole Cengage, UK	2014
		2.	Miller, J., Miller, J. N. Y., Jane, C.	*Statistics and Chemometrics for Analytical Chemistry*	Prentice Hall	2010
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Gulaboski, R.	*Analytical Chemistry (personal authorized lectures available on www.rubingulaboski.synthasite.com and on Repository of Goce Delcev University)*	Goce Delcev University, Stip	2021

Appendix 3 No. 19		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**PHARMACOGNOSY**			
2.	Code	3FMN193725			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Second year / Fourth semester	7.	Number of ECTS	6
8.	Professor	Assoc. Prof. Dr.sc. Viktorija Maksimova			
9.	Pre-conditions for course registration	Enrolled in fourth semester of studies			
10.	**Aims of the study program (competences):** Promote the acquisition of knowledge about medicinal plants, crude drugs obtained from medicinal plants and animals and their biologically active substances. Acquire basic theory and practical methods to determine herbal drug identity and purity. Through the course, students should become familiar with the most important natural raw materials (pharmacognostic drugs) that are significant for medicine and pharmacy. Students will study the definitions and morphological characteristics of drugs according to pharmacopeial regulations, as well as the pharmacological effects and uses of the main active components in drugs and their pharmaceutical applications.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* Definition and subject of pharmacognosy research, history, production and cultivation of drugs; Drugs containing carbohydrates (simple and complex, homo- and heteropolysaccharides, polysaccharides derived from sea algae, plant gums, mucilaginous drugs); Drugs containing proteins, proteids, peptides, or enzymes; Fatty drugs; Drugs containing cyanogenic heterosides; Drugs with glycosylates; Drugs with sulfur and thioheterosides; Drugs with phenolic compounds, phenolic heterosides; Drugs containing coumarins; Drugs with tannins; Drugs with quinones (drugs with naphthodianthrone and anthraquinone heterosides); Drugs with orcinol and phloroglucinol; Drugs with flavonoids; Drugs with terpene compounds (mono-, di-, sesqui-, tri- and tetraterpenes), essential oils, iridoids, valepotriates, etc.; Drugs with triterpene and steroid saponins; Drugs with cardiotonic heterosides; Drugs with tetraterpenes (carotenes); Vitamin drugs; Drugs with organic acids; Drugs containing alkaloids (various groups classified by biosynthetic origin). *Practical part:* Application of methods for determination of herbal drug, their identity and purity. Macroscopic and microscopic characterizations of drug containing carbohydrates; drugs containing proteins and fatty drugs; drugs containing cyanogenic and sulfuric heterosides; drugs with phenolic compounds, phenolic heterosides; drugs containing coumarins; drugs with tannins; drugs with quinones (drugs with naphthodianthrone and anthraquinone heterosides); drugs with orcinol and phloroglucinol; drugs with flavonoids; drugs with terpene compounds (mono-, di-, sesqui-, tri- and tetraterpenes), essential oils, iridoids, valepotriates, etc.; drugs with triterpene and steroid saponins; drugs with cardiotonic heterosides; drugs with tetraterpenes (carotenes); vitamin drugs; drugs with organic acids; drugs containing alkaloids (various groups classified by their biosynthetic origin).				
12.	**Study methods:** Lectures, practical laboratory exercises, consultations, group and individual work (project tasks with oral presentations); three days seminars in the form of fieldwork aimed at recognizing and identifying medicinal plants and pharmacognostic drugs.				
13.	Total amount of time available	6 ECTS x 30 hours = 180 hours (2+3)			
14.	Distribution of tasks	30+45+15+30+60			

15.	Types of learning/teaching activities		15.1.	Lectures – theory	30 hours
			15.2.	Tutorials (laboratory, auditory), seminars, teamwork	45 hours
16.	Other types of activities		16.1.	Projects	15 hours
			16.2.	Individual tasks	30 hours
			16.3.	Home study – tasks	60 hours
17.	Evaluation / assessment methods				
	17.1.	Tests			40 points
	17.2.	Individual tasks / project (presentation: written and oral)			10 points
	17.3.	Activity and participation			20 points
	17.4.	Final exam			30 points
18.	Assessment criteria (points / grade)			Up to 50 points	5 (five) (F)
				51 – 60 points	6 (six) (E)
				61 – 70 points	7 (seven) (D)
				71 – 80 points	8 (eight) (C)
				81 – 90 points	9 (nine) (B)
				91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam			60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.	
20.	Language of the study program			English	
21.	Quality assurance methods of the teaching process			Self-evaluation	

22. Literature

Mandatory literature

No.	Author	Title	Publisher	Year
1.	Upton, R. et al. (Editors)	*American Herbal Pharmacopoeia, Botanical Pharmacognosy*	CRC Press Taylor & Francis	2011
2.	Evans, W. C.	*Trace and Evans Pharmacognosy*	Elsevier	2009
3.	Haensel, R., Sticher, O.	*Pharmacognosy – Phytopharmacy*	Springer	2007

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Glime, J. M., Wagner, D. H.	*Laboratory Techniques: Slide Preparation and Stains*	Michigan Technological University and International Association of Bryologists	2017

<table>
<tr><td colspan="2">Appendix 3
No. 20</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">PHARMACEUTICAL CHEMISTRY 1</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN193825</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Second year /
Fourth semester</td><td>7.</td><td>Number of
ECTS</td><td>7</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Full Prof. Dr.sc. Emilija Janevikj-Ivanovska
Ass. Prof. Dr.sc. Marija Arev</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in fourth semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
The goal of the Pharmaceutical chemistry 1 course is to introduce students to the structure and properties of pharmaceutical substances and metabolites. The course aims to provide fundamental knowledge of the physicochemical properties of medicinal and pharmaceutical substances, the target sites of drug action, as well as the basic mechanisms of drug action and their biotransformation.
The course also explains how specific drugs or drug classes, including inorganic medicinal substances, work, and evaluates their potential value for individuals and populations, with an introduction to inorganic medicinal substances.
Students are expected to obtain knowledge about the physicochemical properties of pharmacologically active molecules, the reactivity of their functional groups, and the chemical and metabolic stability of medicines. They will understand the targets and mechanisms of drug effects at the molecular level, and analyze the relationships between chemical structure, properties, and the effects of medicines.
After passing the exam, students will also be able to apply their theoretical and practical knowledge of inorganic compounds with therapeutic effects.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
1. Introduction to Pharmaceutical Chemistry
— Drug Structure
— Physicochemical Factors Affecting the Biological Activity of Drugs
2. Drug Target Molecules
— Medicines: Structure and Function of Biological Membranes, and Their Role in Drug Transport
— Structure and Function of Proteins
— Nucleic Acids: Structure and Function
— Nucleic Acids as Drug Targets
— Drug Targets: Lipid and Carbohydrates
3. Receptors as Drug Targets
— Structure and Function of Receptors and Their Role in Drug Transport and Signal Transduction
— Types of Receptors (Ion Channels, Transmembrane Receptors, G-Protein Coupled Receptors, Enzyme/Catalytic Receptors, Nuclear Receptors)
4. The Role of Receptors in the Quantitative Determination of Drug Concentration-Activity Relationships
5. Enzymes as Drug Targets
— Enzymes: Structure and Function
— Enzymes as Drug Targets
6. Drug Discovery, Design, and Development: Identifying a Target Molecule
— Drug Design: Optimizing Target Interactions</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">
— Drug Design: Optimizing Target Access
7. Computer-Aided Drug Design
— Combinatorial and Parallel Synthesis
8. Optimization of Pharmacokinetic Parameters
9. Prodrugs
10. Quantitative Structure-Activity Relationships (QSAR)
11. Classification and Nomenclature of Drugs
12. Radiopharmaceuticals and Contrast Agents
— Radiopharmaceuticals for Diagnostics (SPECT, PET) and Therapy
— Production (Labeling, Synthesis) and Quality Control
— Principles of Biodistribution and Clinical Applications
— Contrast Agents: Structure and Application
13. Medicines of Inorganic Origin
— Classification of Drugs According to Their Elemental Composition and Clinical Use
</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, laboratory exercises, consultations, seminars.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">7 ECTS x 30 hours = 210 hours (3+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">45+45+15+25+80</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">25 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">80 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="3">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="3">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="3">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="3">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="3">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="3">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="4">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="4">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="4">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Janevik-Ivanovska, E.</td><td>Фармацевтска хемија 1 (Pharmaceutical chemistry 1)</td><td>Goce Delcev University, Stip</td><td>2014</td></tr>
<tr><td>2.</td><td>Patrick, G. L.</td><td>An Introduction to Medicinal Chemistry (7th Edition)</td><td>Oxford University Press</td><td>2023</td></tr>
</table>

		3.	Lemke, T. L., Williams, D. A., Roche, V. F., Zito, S. W. (Editors)	*Foye's principles of medicinal chemistry (8th Edition)*	Lippincott Williams & Wilkins	2019
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Harrold, M. W., Zavod, R. M.	*Basic concepts in medicinal chemistry (3rd Edition)*	American Society of Health-System Pharmacists (issuing body)	2023
		2.	Alagarsamy, V.	*Textbook of Medicinal Chemistry Volume I*	Elsevier	2010
		3.	Campos Rosa, J. M.	*Pharmaceutical Chemistry (Volume 1): Drug Design and Action (2nd Edition)*	Walter de Gruyter GmbH	2024

<table>
<tr><td colspan="2">Appendix 3
No. 21</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="5">PHYTOCHEMISTRY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="5">3FMN193925</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td colspan="2">Third year /
Fifth semester</td><td>7.</td><td>Number of ECTS</td><td>5</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="5">Assoc. Prof. Dr.sc. Viktorija Maksimova</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="5">Enrolled in fifth semester of studies</td></tr>
<tr><td>10.</td><td colspan="6">Aims of the study program (competences):
Students will:
– acquire knowledge on the physicochemical properties and structures of bioactive substances of natural origin (primary and secondary plant metabolites);
– acquire knowledge on the procedures for extracting active components from plant material, their identification and determination in plant material and herbal preparations (color reactions, precipitate reactions; spectrophotometric techniques; thin-layer chromatography, liquid and gas chromatography);
– familiarize with basic analytical techniques for testing of herbal drugs;
– be able to browse through scientific and professional literature related to methods for the analysis of phytochemicals.</td></tr>
<tr><td>11.</td><td colspan="6">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
The course enhances the knowledge of the students on different pathways of primary and secondary metabolism in plants.
Secondary metabolites important in medicinal plants, as well as glycosides (classification and their properties); phenolic compounds (phenols and phenolic acids, coumarins, lignans, tannins, anthraquinones, flavonoids, terpene compounds: mono-, di-, tri-, tetraterpene compounds); Alkaloids: concept, classification; derivatives of ornithine and lysine; derivatives of phenylalanine and tyrosine; derivatives of histidine, purine bases; Pseudoalkaloids; Terpene alkaloids; Steroid alkaloids, their occurrence, chemical structure, biosynthetic pathways of formation, assays for identification and quantification are going to be studied through this course.
Practical part:
The practical part of the course will contribute for gaining skills on the extraction methods, observing physicochemical properties, qualitative and quantitative determination of primary and secondary plant metabolites covered in the theoretical part.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, theoretical and practical laboratory exercises, consultations, group and individual work (project assignments with oral presentations).</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">5 ECTS x 30 hours = 150 hours (2+2)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">30+30+15+15+60</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td colspan="2">Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td colspan="2">15 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td colspan="2">15 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td colspan="2">60 hours</td></tr>
<tr><td rowspan="2">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
</table>

	17.2.	Individual tasks / project (presentation: written and oral)		10 points
	17.3.	Activity and participation		20 points
	17.4.	Final exam		30 points
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)
			51 – 60 points	6 (six) (E)
			61 – 70 points	7 (seven) (D)
			71 – 80 points	8 (eight) (C)
			81 – 90 points	9 (nine) (B)
			91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.	
20.	Language of the study program		English	
21.	Quality assurance methods of the teaching process		Self-evaluation	

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	Ganora, L.	*Herbal Constituents (2nd Edition): Foundations of Phytochemistry*	HerbalChem Press	2021
2.	Chukwuebuka, E., Chinenye Ifemeje, J., Chidi Udedi, S., Kumar, S.	*Phytochemistry (Volume 1): Fundamentals, Modern Techniques, and Applications*	Apple Academic Press	2019
3.	Arnason, J. T., Mata, R., Romeo, J. T.	*Phytochemistry of Medicinal Plants*	Springer	1995

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Fattorusso, E., Taglialatela-Scafati, O. (Editors)	*Modern Alkaloids*	Wiley-VCH	2008

Appendix 3 No. 22			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**PHARMACEUTICAL TECHNOLOGY 1**			
2.	Code		3FMN194025			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Third year / Fifth semester	7.	Number of ECTS	7
8.	Professor		Assoc. Prof. Dr.sc. Elena Drakalska Sersemova			
9.	Pre-conditions for course registration		Enrolled in fifth semester of studies			
10.	**Aims of the study program (competences):** Understanding of the fundamental principles of formation, the technological processes employed during manufacturing, and the pharmaceutical-technological evaluations essential for assessing pharmaceutical dosage forms.					
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. Definition of the course, meaning and essential terminology; 2. Types and classifications of pharmaceutical dosage forms; 3. Evaluation of Pharmacopoeia; 4. Pharmacy, Prescription, Dosage of Drugs, Manufacturing, and Dispensing of Drugs; 5. Pharmaceutical Milling and Sieving Technologies, Fundamentals of Pharmaceutical Mixing; 6. Heat operations, Fundamental principles of drying; 7. Definition, process and techniques of filtration, Compression; 8. Introduction and general considerations of sterile manufacture, Stability monitoring; 9. Rheological characterization of pharmaceutical formulations; 10. Characterization, classification and advantages of pharmaceutical powders; 11. Properties, types and quality of solutions; 12. Classification and applications of pharmaceutical excipients. *Practical part:* 1. Introduction / Comparative Overview of Pharmacopoeias; 2. Prescription and Pharmacy Practice; 3. Pharmaceutical-Technological Operations – Measuring, Weighing, Dissolving; 4. Comminution and Sieving of Powders; Characterization of Powders; 5. Particle Size Analysis; 6. Powder Mixing – Homogeneity Testing of a Mixture; 7. Solution Phenomena; Dissolution Process of Solids; Measurement of Tablet Dissolution; 8. Solution Phenomena; Diffusion – Determination of the Partition Coefficient of Salicylic Acid in a Water/Chloroform Solvent System; 9. Interfacial Processes; Filtration; 10. Drying – Determination of the Drying Rate of Solid Material (Powder, Granulate); 11. Extraction – Non-aqueous Extraction Procedures; 12. Aqueous Extraction Preparations.					
12.	**Study methods:** Lectures, interactive teaching and research work.					
13.	Total amount of time available		7 ECTS x 30 hours = 210 hours (3+3)			
14.	Distribution of tasks		45+45+0+90+30			
15.		15.1.	Lectures – theory		45 hours	

	Types of learning/teaching activities		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	45 hours
16.	Other types of activities		16.1.	Projects	0 hours
			16.2.	Individual tasks	90 hours
			16.3.	Home study – tasks	30 hours
17.	Evaluation / assessment methods				
	17.1.	Tests			40 points
	17.2.	Individual tasks / project (presentation: written and oral)			10 points
	17.3.	Activity and participation			20 points
	17.4.	Final exam			30 points
18.	Assessment criteria (points / grade)			Up to 50 points	5 (five) (F)
				51 – 60 points	6 (six) (E)
				61 – 70 points	7 (seven) (D)
				71 – 80 points	8 (eight) (C)
				81 – 90 points	9 (nine) (B)
				91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam			60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.	
20.	Language of the study program			English	
21.	Quality assurance methods of the teaching process			Self-evaluation	

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	Angelovska, B., Drakalska, E., Cvetkovski, A.	*Pharmaceutical-technological operations (script)*	Goce Delcev University, Stip	2015
2.	Vuleta, G., Milic, J., Primorac, M., Savic, S.	*Pharmaceutical technology 1*	Faculty of Pharmacy, Belgrade	2019
3.	Taylor, K. M. G.	*Aulton's Pharmaceutics (6th Edition)*	Elsevier	2021

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Semalty, A., Semalty, M., Rawat, M. S. M.	*Essentials of Pharmaceutical Technology*	Pharmamed Press	2011
2.	Bhatt, P.	*Handbook of Pharmaceutical Technology*	Lap Lambert Academic Publishing	2021
3.	Kluwer, V.	*Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems (9th Edition)*	Lippincott Williams & Wilkins	2011

<table>
<tr><td colspan="2">Appendix 3
No. 23</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">PHARMACEUTICAL CHEMISTRY 2</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN194125</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Third year /
Fifth semester</td><td>7.</td><td>Number of
ECTS</td><td>7</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Full Prof. Dr.sc. Emilija Janevikj-Ivanovska
Ass. Prof. Dr.sc. Marija Arev</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in fifth semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
The objective of the course Pharmaceutical chemistry 2 is the chemical study of drugs and the active ingredients of drugs in order to determine the relationship between chemical structure, physicochemical properties, reactivity, chemical structure-biological activity relationships, drug-drug interactions, drug-receptor interactions, chemical aspect of drug metabolism and biological response, with the ultimate aim of providing the knowledge necessary for the creation of new drugs.
Students are expected to:
– understand the interrelation between structure, physicochemical properties, pharmacological activity, and therapeutic utility;
– know the methods and strategies used in the generation of drugs;
– know the interactions between drugs and their biological targets;
– know and propose the structural modifications that affect the properties of the drugs;
– know the general methods and the synthetic strategies for the preparation of drugs;
– know the analytical and spectroscopic methods applicable to the structural identification and elucidation of drugs, and related compounds;
– be able to name and formulate a drug in accordance with the systematic IUPAC nomenclature;
– know and become able to predict the transformation of drugs in the body;
– know and be able to estimate the risks associated with the use of reagents, solvents and the development of processes in the chemical laboratory;
– know how to acquire and use information related to drugs.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
1. Drugs affecting the processes of haemostasis and thrombosis
– Antiaggregating drugs / Antiplatelet drugs
– Anticoagulant drugs
– Antihemorrhagic drugs
– Plasma expanders
2. Medicines that act on the processes of calcium homeostasis and treatment of bone diseases
3. Trace elements / Oligoelements
4. Vitamins and related compounds
– Water-soluble vitamins
– Fat-soluble vitamins
– Related compounds
5. Medicines that affect hormonal systems
– Drugs with a protein structure
– Drugs with a steroid structure
– Oral hypoglycemic drugs</td></tr>
</table>

<table>
<tr><td></td><td colspan="4">6. Medicines that affect the processes of the gastrointestinal system
— Antiulcer Drugs
— Antidiarrheal Drugs
— Medicine for Hepatobiliary Diseases
7. Medicines that affect inflammatory processes and allergic reactions
— Antihistamines
— Prostaglandins
— Analgesics
— Antipyretics
— Non-steroidal anti-inflammatory drugs – NSAIDs
8. Medicines that affect infections
— Antibiotics
— Quinolone Antibacterial Drugs
— Antibacterial Sulfonamides
— Antitubercular Drugs
— Antifungal Drugs
— Antiviral Drugs
— Anti-amoebic Drugs
— Antimalarial Drugs
— Anthelmintics
— Antileprotic Drugs
9. Antineoplastic drugs
— Antimetabolites
— Antitubulin Drugs
— Nucleic Acids as Therapeutic Targets and Drugs
— Small-Molecule Targeted Therapies
— Antibody-Based Therapies
— Endocrine Therapies
— Immunomodulatory Therapies
— Alternative Tumor-Targeting Strategies
— Chemopreventive Agents</td></tr>
<tr><td>12.</td><td colspan="4">Study methods:
Lectures, laboratory exercises, consultations, seminars.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="2">7 ECTS x 30 hours = 210 hours (3+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="2">45+45+15+25+80</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>45 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>25 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>80 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="4">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="2">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="2">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="2">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="2">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
</table>

19.	Eligibility for signature and taking the final exam			60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.		
20.	Language of the study program			English		
21.	Quality assurance methods of the teaching process			Self-evaluation		
22.	Literature					
	22.1.	Mandatory literature				
		No.	Author	Title	Publisher	Year
		1.	Patrick, G. L.	*An Introduction to Medicinal Chemistry (7th Edition)*	Oxford University Press	2023
		2.	Lemke, T. L., Williams, D. A., Roche, V. F., Zito, S. W. (Editors)	*Foye's principles of medicinal chemistry (8th Edition)*	Lippincott Williams & Wilkins	2019
		3.	Alagarsamy, V.	*Textbook of Medicinal Chemistry Volume II (2nd Edition)*	Elsevier	2010
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Harrold, M. W., Zavod, R. M.	*Basic concepts in medicinal chemistry (3rd Edition)*	American Society of Health-System Pharmacists (issuing body)	2023
		2.	Bhattacharjee, M. K.	*Chemistry of Antibiotics and Related Drugs (2nd Edition)*	Springer	2022
		3.	Thurston, D. E., Pysz, I.	*Chemistry and Pharmacology of Anticancer Drugs*	CRC Press Taylor & Francis	2021

Appendix 3 No. 24			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**PHARMACOLOGY 1**			
2.	Code		3FMN194225			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Third year / Fifth semester	7.	Number of ECTS	5
8.	Professor		Assoc. Prof. Dr.sc. Marija Darkovska Serafimovska			
9.	Pre-conditions for course registration		Enrolled in fifth semester of studies			
10.	**Aims of the study program (competences):** Acquiring knowledge of general pharmacology (pharmacokinetics and pharmacodynamics), as well as adverse effects on drugs, drug addiction, doses and dosing of drugs and basic knowledge of toxicology.					
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* Introduction to pharmacology; Development of a new drug; Pharmacokinetics (absorption, distribution, metabolism and elimination of medicines); Pharmacodynamics (the mechanism of action of medicines); Synergism, antagonism, drug interactions, accumulation and tolerance; The concept of dose, dosing of drugs, dependence of the effect of the drug on the dose; Adverse effects of medicines; Addiction to medicines. *Practical part:* Recipe and recipe parts. Students will learn how to prescribe medications and gain an understanding of all pharmaceutical dosage forms.					
12.	**Study methods:** Lectures, exercises, group discussion methods, individual work.					
13.	Total amount of time available		5 ECTS x 30 hours = 150 hours (2+2)			
14.	Distribution of tasks		30+30+30+30+30			
15.	Types of learning/teaching activities	15.1.	Lectures – theory		30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork		30 hours	
16.	Other types of activities	16.1.	Projects		30 hours	
		16.2.	Individual tasks		30 hours	
		16.3.	Home study – tasks		30 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			40 points	
	17.2.	Individual tasks / project (presentation: written and oral)			10 points	
	17.3.	Activity and participation			20 points	
	17.4.	Final exam			30 points	
18.	Assessment criteria (points / grade)		Up to 50 points		5 (five) (F)	
			51 – 60 points		6 (six) (E)	
			61 – 70 points		7 (seven) (D)	
			71 – 80 points		8 (eight) (C)	
			81 – 90 points		9 (nine) (B)	
			91 – 100 points		10 (ten) (A)	
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.			
20.	Language of the study program		English			

<table>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="5">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Darkovska Serafmovska, M.</td><td>Authorized lectures</td><td>Goce Delcev University, Stip</td><td>2024</td></tr>
<tr><td>2.</td><td>Ritter, J. M., Flower, R. J., Henderson, G., Loke, Y. K., MacEwan, D., Rang, H. P.</td><td>Rang & Dale's Pharmacology (9th Edition)</td><td>Elsevier</td><td>2020</td></tr>
<tr><td>3.</td><td>Trevor, A. J., Katzung, B. G., Knuidering-Hall, M.</td><td>Katzung & Trevor's Pharmacology: Examination & Board Review (12th Edition)</td><td>McGraw Hill</td><td>2019</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Brunton, L. L., Knollmann, B. C.</td><td>Goodman & Gilman's: The Pharmacological Basis of Therapeutics (14th Edition)</td><td>McGraw Hill</td><td>2022</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 25</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="5">IMMUNOLOGY AND IMMUNOCHEMISTRY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="5">3FMN194325</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td colspan="2">Third year /
Fifth semester</td><td>7.</td><td>Number of ECTS</td><td>6</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="5">Assoc. Prof. Dr.sc. Darinka Gjorgieva Ackova</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="5">Enrolled in fifth semester of studies</td></tr>
<tr><td>10.</td><td colspan="6">Aims of the study program (competences):
The subject enables students to obtain theoretical and practical knowledge in the field of immunology; Special attention is paid to the understanding of immunological mechanisms in the development of the immune response in health and disease, the types of immune cells involved in its development, immunochemical reactions and methods in immunodiagnostics, as well as the possibilities for the development of modern immunotherapies.</td></tr>
<tr><td>11.</td><td colspan="6">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. Introduction to immunology;
2. Cells, tissues and organs involved in the immune system;
3. Innate (non-specific) immunity;
4. Acquired (specific) immunity. Cellular and humoral immunity;
5. Antigens and antibodies;
6. Acquisition, generation and presentation of antigens;
7. Cytokines;
8. Complement system;
9. Immune tolerance, autoimmunity and autoimmune diseases;
10. Hypersensitivity reactions;
11. Immunodeficiency;
12. Immune response to non-infectious antigens (carcinogens);
13. Vaccines and active/passive immunization.
Practical part:
1. Cells and organs of the immune system;
2. Blood smear; Microscopic preparations of lymphoid cells and tissues;
3. Immunological techniques and methods for isolating and purifying immune cells;
4. Agglutination reactions (non-precipitating antibodies);
5. Immunoprecipitation and immunodiffusion;
6. Electrophoretic methods and immunoblotting;
7. Tests based on the lytic activity of complement;
8. Immunoassays using different markers (RIA, ELISA…);
9. Immunofluorescence;
10. Flow cytometry;
11. Serums and vaccines;
12. Selected protocols for performing various immunological tests.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, theoretical and laboratory exercises, project assignments, consultations.
Laboratory exercises are performed in small groups of up to 10 students.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">6 ECTS x 30 hours = 180 hours (2+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">30+45+30+30+45</td></tr>
<tr><td>15.</td><td></td><td>15.1.</td><td colspan="2">Lectures – theory</td><td colspan="2">30 hours</td></tr>
</table>

	Types of learning/teaching activities		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	45 hours
16.	Other types of activities		16.1.	Projects	30 hours
			16.2.	Individual tasks	30 hours
			16.3.	Home study – tasks	45 hours
17.	Evaluation / assessment methods				
	17.1.	Tests			40 points
	17.2.	Individual tasks / project (presentation: written and oral)			10 points
	17.3.	Activity and participation			20 points
	17.4.	Final exam			30 points
18.	Assessment criteria (points / grade)			Up to 50 points	5 (five) (F)
				51 – 60 points	6 (six) (E)
				61 – 70 points	7 (seven) (D)
				71 – 80 points	8 (eight) (C)
				81 – 90 points	9 (nine) (B)
				91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam			60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.	
20.	Language of the study program			English	
21.	Quality assurance methods of the teaching process			Self-evaluation	

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	Owen, J. A., Punt, J., Stranford, S. A.	*Kuby Immunology (7th Edition)*	W. H. Freeman and Company	2013
2.	Murphy, L., Weaver, C., Berg, L.	*Janeway's immunobiology (10th Edition)*	W. W. Norton & Company	2022
3.	Gjorgieva Ackova D.	*Authorized lectures*	Goce Delcev University, Stip	2024

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Del Valle, L. (Editor)	*Immunochemistry and immunocytochemistry: Methods and protocols (1st Edition)*	Humana Press	2022
2.	O'Gorman, M. R. G., Donnenberg, A. D. (Editors)	*Handbook of human immunology (2nd Edition)*	CRC Press	2008
3.	World Health Organization	*Manual of basic techniques for a health laboratory (2nd Edition)*	World Health Organization	2012
4.	Gjorgieva Ackova, D.	*Immunochemistry and immunology (Имунохемија со имунологија)*	Goce Delcev University, Stip	2022

Appendix 3 No. 26		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**PHARMACEUTICAL TECHNOLOGY 2**			
2.	Code	3FMN194425			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Third year / Sixth semester	7.	Number of ECTS	7
8.	Professor	Assoc. Prof. Dr.sc. Elena Drakalska Sersemova			
9.	Pre-conditions for course registration	Enrolled in sixth semester of studies			
10.	**Aims of the study program (competences):** Understanding of the fundamental principles of formulation, and technological processes employed during manufacturing, and the pharmaceutical-technological evaluations essential for assessing pharmaceutical dosage forms.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. Characteristics of Polyphasic Systems; 2. Physicochemical aspects of suspensions, Approaches to suspension formulation, Stability determination; 3. Emulsions (Types of Emulsions, Formulation, Factors Affecting Viscosity, Testing, and Biopharmaceutical Aspects); 4. Emulsifiers (Types of Emulsifiers, HLB Value, Chemical groups of surface-active agents, Mixed Emulsifiers, Polymeric Emulsifiers); 5. Classification and properties of semisolid preparations for topical application, Selection of bases for formulation; 6. Creams (Lipophilic and hydrophilic creams, Preparation, Pharmaceutical-technological testing); 7. Ointments (Preparation, Types of ointment bases, Characterization); 8. Structure of gels (Preparation, Testing, and Use of Hydrophilic Gels); 9. Characterization and evaluation of medical pastes; 10. Pharmaceutical forms for application in body cavities; 11. Suppositories, Vaginal Tablets, Ocular Inserts (Preparation, characterization, and Pharmaceutical-technological testing); 12. Testing for active substance release from semisolid preparations and stability assessment. *Practical part:* 1. Preparation of suspensions, stability monitoring and storage; 2. Emulsion Preparation, Stabilization, Types of Emulsion; 3. Classification and Evaluation of Inhalations, Types of Preparations, Propellants, and Storage; 4. Ointment Preparation, Classification of Ointment Bases; 5. Types of creams, Preparation, and Applications; 6. Medical Gels, Characterization and Storage; 7. Medical Pastes, Classification and Preparation; 8. Characterization of Suppositories for Rectal Application, Calculation of Displacement Factor; 9. Preparation and Evaluation of Vaginal Tablets; 10. Preparation for Final Practical Exercise; 11. Final Practical Exercise.				
12.	**Study methods:**				

	Lectures, interactive teaching and research work.				
13.	Total amount of time available		7 ECTS x 30 hours = 210 hours (3+3)		
14.	Distribution of tasks		45+45+0+90+30		
15.	Types of learning/teaching activities	15.1.	Lectures – theory	45 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	45 hours	
16.	Other types of activities	16.1.	Projects	0 hours	
		16.2.	Individual tasks	90 hours	
		16.3.	Home study – tasks	30 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	
	17.2.	Individual tasks / project (presentation: written and oral)		10 points	
	17.3.	Activity and participation		20 points	
	17.4.	Final exam		30 points	
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)	
			51 – 60 points	6 (six) (E)	
			61 – 70 points	7 (seven) (D)	
			71 – 80 points	8 (eight) (C)	
			81 – 90 points	9 (nine) (B)	
			91 – 100 points	10 (ten) (A)	
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.		
20.	Language of the study program		English		
21.	Quality assurance methods of the teaching process		Self-evaluation		

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	Drakalska Sersemova, E., Angelovska, B., Cvetkovski, A.	*Pharmaceutical Technology 2 (Book)*	Goce Delcev University, Stip	2024
2.	Vuleta, G., Milic, J., Primorac, M., Savic, S.	*Pharmaceutical Technology 1*	Faculty of Pharmacy, Belgrade	2019
3.	Taylor, K. M. G.	*Aulton's Pharmaceutics (6th Edition)*	Elsevier	2021

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Semalty, A., Semalty, M., Rawat, M. S. M.	*Essentials of Pharmaceutical Technology*	Pharmamed Press	2011
2.	Bhatt, P.	*Handbook of Pharmaceutical Technology*	Lap Lambert Academic Publishing	2021
3.	Kluwer, V.	*Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems (9th Edition)*	Lippincott Williams & Wilkins	2011

Appendix 3 No. 27		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**PHARMACEUTICAL CHEMISTRY 3**			
2.	Code	3FMN194525			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Third year / Sixth semester	7.	Number of ECTS	7
8.	Professor	Full Prof. Dr.sc. Emilija Janevik-Ivanovska Ass. Prof. Dr.sc. Marija Arev			
9.	Pre-conditions for course registration	Enrolled in sixth semester of studies			
10.	**Aims of the study program (competences):** The objective of the course Pharmaceutical chemistry 3 is the chemical study of drugs and the active ingredients of drugs in order to determine the relationship between chemical structure, physicochemical properties, reactivity, chemical structure-biological activity relationships, drug-drug interactions, drug-receptor interactions, chemical aspect of drug metabolism and biological response, with the ultimate aim of providing the knowledge necessary for the creation of new drugs. Students are expected to: – understand the interrelation between structure, physicochemical properties, pharmacological activity, and therapeutic utility; – know the methods and strategies used in the generation of drugs; – know the interactions between drugs and their biological targets; – know and propose the structural modifications that affect the properties of the drugs; – know the general methods and the synthetic strategies for the preparation of drugs; – know the analytical and spectroscopic methods applicable to the structural identification and elucidation of drugs, and related compounds; – be able to name and formulate a drug in accordance with the systematic IUPAC nomenclature; – know and become able to predict the transformation of drugs in the body; – know and be able to estimate the risks associated with the use of reagents, solvents and the development of processes in the chemical laboratory; know how to acquire and use information related to drugs.				
11.	**Content of the study program (applies both for theoretical and practical part):** 1. Medicines that affect the immune system – Immunosuppressives – Immunostimulatory 2. Drugs affecting the central nervous system – Sedatives – Hypnotics – Tranquilizers – Antidepressants – CNS stimulants – Narcotic analgesics – Anticonvulsants – Drugs for Parkinson’s disease – Skeletal muscle relaxants – Drugs for Alzheimer’s disease				

<table>
<tr><td></td><td colspan="6">
— General anesthetics
— Local anesthetics
3. Medicines that affect the peripheral nervous system
— Adrenergic drugs
— Cholinergic drugs
— Adrenergic blockers
— Anticholinergic drugs
4. Medicines affecting the cardiovascular system
— Antihypertensive drugs
— Antiarrhythmic drugs
— Antianginal drugs
— Antihyperlipidemic drugs
5. Medicines that affect the genitourinary system
— Diuretics
6. Medicines that affect the ocular, nasal and pulmonary systems
— Expectorants
— Antitussives
7. Management of disease states – rheumatoid arthritis, obesity
8. Biological preparations used in the treatment of diseases
9. Performance enhancing drugs and doping
</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, laboratory exercises, consultations, seminars.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">7 ECTS x 30 hours = 210 hours (3+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">45+45+15+25+80</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">25 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">80 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="2">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="2">Self-evaluation</td></tr>
<tr><td rowspan="4">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Patrick, G. L.</td><td>An Introduction to Medicinal Chemistry (7th Edition)</td><td>Oxford University Press</td><td>2023</td></tr>
</table>

		2.	Lemke, T. L., Williams, D. A., Roche, V. F., Zito, S. W. (Editors)	*Foye's principles of medicinal chemistry (8th Edition)*	Lippincott Williams & Wilkins	2019
		3.	Alagarsamy, V.	*Textbook of Medicinal Chemistry Volume II (2nd Edition)*	Elsevier	2010
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Harrold, M. W., Zavod, R. M.	*Basic concepts in medicinal chemistry (3rd Edition)*	American Society of Health-System Pharmacists (issuing body)	2023
		2.	Bhattacharjee, M. K.	*Chemistry of Antibiotics and Related Drugs (2nd Edition)*	Springer	2022
		3.	Thurston, D. E., Pysz, I.	*Chemistry and Pharmacology of Anticancer Drugs*	CRC Press Taylor & Francis	2021

Appendix 3 No. 28			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**PHARMACOLOGY 2**			
2.	Code		3FMN194625			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Third year / Sixth semester	7.	Number of ECTS	6
8.	Professor		Assoc. Prof. Dr.sc. Marija Darkovska Serafimovska			
9.	Pre-conditions for course registration		Enrolled in sixth semester of studies;			
10.	**Aims of the study program (competences):** Acquiring knowledge of special pharmacology, in the sense of the pharmacodynamic groups and their therapeutic areas.					
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* Medicines that act on the central nervous system (anxiolytics and hypnotics, antidepressants, antiepileptics, antiparkinsonian drugs, neuroleptics, analgesics, general anesthetics, local anesthetics, relaxant drugs, drugs for the treatment of Alzheimer's disease); Medicines that cat on the respiratory system; Medicines that act on the cardiovascular system (therapy for heart failure, antiarrhythmics, treatment for angina pectoris, antihypertensives / diuretics), Haemostasis and thrombosis, Therapy for anemia, Hematology; Medicines acting on the digestive system; Medicines acting on the urinary system; Hormones; Antimicrobial drugs; Medicines in the therapy of malignant diseases. *Practical part:* Students will learn to prescribe drugs for different pharmacotherapeutic groups, with special reference to indications, mechanism of action, and side effects.					
12.	**Study methods:** Lectures, exercises, group discussion methods, individual work.					
13.	Total amount of time available		6 ECTS x 30 hours = 180 hours (3+2)			
14.	Distribution of tasks		45+30+15+30+30			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	45 hours		
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours		
16.	Other types of activities	16.1.	Projects	30 hours		
		16.2.	Individual tasks	30 hours		
		16.3.	Home study – tasks	45 hours		
17.	Evaluation / assessment methods					
	17.1.	Tests		40 points		
	17.2.	Individual tasks / project (presentation: written and oral)		10 points		
	17.3.	Activity and participation		20 points		
	17.4.	Final exam		30 points		
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)		
			51 – 60 points	6 (six) (E)		
			61 – 70 points	7 (seven) (D)		
			71 – 80 points	8 (eight) (C)		
			81 – 90 points	9 (nine) (B)		
			91 – 100 points	10 (ten) (A)		
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.			

<table>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Darkovska Serafmovska, M.</td><td>Authorized lectures</td><td>Goce Delcev University, Stip</td><td>2024</td></tr>
<tr><td>2.</td><td>Ritter, J. M., Flower, R. J., Henderson, G., Loke, Y. K., MacEwan, D., Rang, H. P.</td><td>Rang & Dale's Pharmacology (9th Edition)</td><td>Elsevier</td><td>2020</td></tr>
<tr><td>3.</td><td>Trevor, A. J., Katzung, B. G., Knuidering-Hall, M.</td><td>Katzung & Trevor's Pharmacology: Examination & Board Review (12th Edition)</td><td>McGraw Hill</td><td>2019</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Brunton, L. L., Knollmann, B. C.</td><td>Goodman & Gilman's: The Pharmacological Basis of Therapeutics (14th Edition)</td><td>McGraw Hill</td><td>2022</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 29</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">BASICS OF SCIENTIFIC RESEARCH AND BIOSTATISTICS</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN194725</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Third year /
Sixth semester</td><td>7.</td><td>Number of ECTS</td><td>4</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Full Prof. Dr. sc. Milka Zdravkovska
Ass. Prof. Dr.sc. Stefan Arsov</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in sixth semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
Acquiring knowledge about the basics of medical biostatistics – ways of collecting data, grouping the data series and their statistical table and graph. Learning basic parametric and nonparametric tests, demographic and vital statistics.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. Concept and development of biostatistics; Statistical table, sample units, types and properties of statistics, statistical series (attribute: numerical, spatial, temporal);
2. Tabular and graphical presentation of statistical series. Analysis of the structure of the series attribute tokens (proportions, rates, and indices);
3. Analysis of the structure of the series with numerical characteristics (mean, median, mode);
4. Measures of variability: mean deviation, variance and standard deviation, coefficient of variation;
5. Hypothesis / testing of hypothesis, analysis of statistical relationships (chi-square test);
6. Analysis of the relationships in series with numerical characters (Pearson correlation coefficient t, Spearman t rank correlation coefficient, and multiple correlation);
7. Testing the significance of differences between two environments and arithmetic between two proportions (Student t-test for independent and dependent samples);
8. Examination of the dynamics of phenomena (trend, seasonal index);
9. Vital Statistics, Concepts and sources in demographic statistics;
10. Types of studies (descriptive and analytical studies);
11. Experimental study (randomization, control and test group);
12. Structure of scientific paper (introduction, results, methods, and discussion).
Practical part:
1. Plan for statistic research;
2. Indices dynamics with constant and variable basis;
3. Calculating the arithmetic mean in non-grouped data, grouped in the interval group and the group without grouped interval;
4. Calculating the median and the mode non-grouped and grouped data;
5. Standard deviation in non-grouped and grouped data; Coefficient of variation;
6. Pearson correlation coefficient of t in non-group data;
7. Estimation of parameters of the sample (π parameter and the parameter μ);
8. Student t-test for two independent large samples and in two proportions;
9. Linear trend of time series (for odd and even number of years), seasonal index;
10. Analysis of a scientific paper (part 1);
11. Analysis of a scientific paper (part 2);
12. Analysis of a scientific paper (part 3).</td></tr>
</table>

12.	**Study methods:** Small group work, homework, practical work, project assignments, discussion.					
13.	Total amount of time available			4 ECTS x 30 hours = 120 hours (2+1)		
14.	Distribution of tasks			30+15+15+30+30		
15.	Types of learning/teaching activities		15.1.	Lectures – theory	30 hours	
			15.2.	Tutorials (laboratory, auditory), seminars, teamwork	15 hours	
16.	Other types of activities		16.1.	Projects	15 hours	
			16.2.	Individual tasks	30 hours	
			16.3.	Home study – tasks	30 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			40 points	
	17.2.	Individual tasks / project (presentation: written and oral)			10 points	
	17.3.	Activity and participation			20 points	
	17.4.	Final exam			30 points	
18.	Assessment criteria (points / grade)			Up to 50 points	5 (five) (F)	
				51 – 60 points	6 (six) (E)	
				61 – 70 points	7 (seven) (D)	
				71 – 80 points	8 (eight) (C)	
				81 – 90 points	9 (nine) (B)	
				91 – 100 points	10 (ten) (A)	
19.	Eligibility for signature and taking the final exam			60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.		
20.	Language of the study program			English		
21.	Quality assurance methods of the teaching process			Self-evaluation		
22.	Literature					
	22.1.	Mandatory literature				
		No.	Author	Title	Publisher	Year
		1.	Jekel, J. F., Katz, D. L., Elmore, J. G, Wild, D.	*Epidemiology, Biostatistics, and Preventive Medicine*	Elsevier	2007
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.				

Appendix 3 No. 30		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**PHYTOTHERAPY**			
2.	Code	3FMN194825			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Third year / Sixth semester	7.	Number of ECTS	6
8.	Professor	Assoc. Prof. Dr.sc. Viktorija Maksimova			
9.	Pre-conditions for course registration	Enrolled in sixth semester of studies			
10.	**Aims of the study program (competences):** Familiarizing students with the basics of rational phytotherapy, its role in primary healthcare and self-medication; current regulations for herbal products (regulations in the Republic of North Macedonia; European regulations, Expanded Commission E Monographs, WHO monographs); indications, contraindications, side effects, and interactions of herbal medicines; monograph of officinal herbal drugs; identification and determination of active components in herbal medicines; efficacy and mechanism of action of herbal medicines on the gastrointestinal tract, cardiovascular system, respiratory system, nervous system, reproductive system, urinary system, and skin system.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* Concept of rational phytotherapy, herbal preparations, and herbal medicines, relevant legal regulations; Herbal preparations and diseases of the nervous system; Herbal preparations and diseases of the cardiovascular system; Herbal preparations and diseases of the respiratory system; Herbal preparations and diseases of the digestive system; Herbal preparations and diseases of the liver and biliary system; Herbal preparations and diseases of the reproductive system; Herbal preparations and diseases of the urogenital system; Herbal preparations as adaptogenic drugs; Herbal preparations and their influence on the immune system; Safety and efficacy of herbal preparations; Control and quality of herbal preparations. *Practical part:* Rational phytotherapy, EMA (European Medicines Agency) monographs; Using monographs from the European Pharmacopoeia for checking the quality of herbal drugs; Using monographs from the World Health Organization related to herbal substances (drugs); Other exercises correspond to the thematic chapters from the theoretical part, in the context of herbal preparations and their effects on different organ systems.				
12.	**Study methods:** Lectures, theoretical and practical exercises, consultations; preparation of an independent seminar paper; practical laboratory and classroom exercises in small groups of 10 students.				
13.	Total amount of time available	6 ECTS x 30 hours = 180 hours (3+2)			
14.	Distribution of tasks	45+30+30+30+45			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	45 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours	
16.	Other types of activities	16.1.	Projects	30 hours	
		16.2.	Individual tasks	30 hours	
		16.3.	Home study – tasks	45 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	
	17.2.	Individual tasks / project (presentation: written and oral)		10 points	
	17.3.	Activity and participation		20 points	

<table>
<tr><td></td><td colspan="2">17.4. Final exam</td><td colspan="3">30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="9">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="4">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Khan, M. S. A., Ahmad, H., Chattopadhyay, D.</td><td>New Look to Phytomedicine: Advancements in Herbal Products as Novel Drug Leads</td><td>Elsevier</td><td>2018</td></tr>
<tr><td>2.</td><td>Schulz, V., Hansel, R., Blumenthal, M., Tyler, V.</td><td>Rational Phytotherapy: A Reference Guide for Physicians & Pharmacists (5th Edition)</td><td>Springer</td><td>2004</td></tr>
<tr><td>3.</td><td>Duke, J. A., Bogenschutz Godwin, M. J., Cellier, J. D., Duke, P. A.</td><td>Handbook of medicinal herbs</td><td>CRC Press</td><td>2002</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="4">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Chevallier, A.</td><td>Encyclopedia of herbal medicines (3rd Edition)</td><td>Penguin Random House</td><td>2016</td></tr>
<tr><td>2.</td><td>Council of Europe</td><td>European Pharmacopoeia (8th Edition)</td><td>Council of Europe</td><td>2014</td></tr>
</table>

Appendix 3 No. 31		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**PHARMACEUTICAL TECHNOLOGY 3**			
2.	Code	3FMN194925			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Fourth year / Seventh semester	7.	Number of ECTS	7
8.	Professor	Assoc. Prof. Dr.sc. Aleksandar Cvetkovski			
9.	Pre-conditions for course registration	Enrolled in seventh semester of studies			
10.	**Aims of the study program (competences):** Acquiring knowledge in the basic principles in the development of formulations for solid dosage forms, parenteral preparations and dosage forms for immunization, as well as for blood and blood derivatives, technological procedures during their production and quality control parameters during production processes and final products.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. Solid pharmaceutical dosage forms, granules; 2. Tablets; 3. Capsules; 4. Coated pharmaceutical dosage forms; 5. Sterile pharmaceutical dosage forms; 6. Isotonic solutions, buffer solutions; 7. Parenteral preparations, injections; 8. Infusions; 9. Solutions for hemodialysis and peritoneal dialysis; 10. Eye preparations; 11. Immunobiological dosage forms; 12. Blood and blood derivatives dosage forms. *Practical part:* 1. Techniques for making basic granulate (*Granulatum simplex*), and recipes for *Carbonis medicinalis granulate*, and effervescent granulate; 2. Pharmaceutical-technological tests for powdered material (analysis of particle size – fine analysis; density of powders – real and apparent density after taping; examinations of flow properties; assessment of moisture in granulate); 3. Technological procedures for making tablets and pharmaceutical-technological tests of tablets according to Ph. Eur. (making a dissolution profile of a conventional tablet); 4. Technological procedures for making capsules and pharmaceutical-technological tests of capsules according to Ph. Eur. (making a dissolution profile of a conventional capsule); 5. Creation of a dissolution profile of a conventional solid dosage form and a dosage form with a modified release and their comparison (*in vitro* monitoring of the release rate of medicinal substances from solid dosage forms); 6. Testing of sterility and testing of the presence of pyrogens in a pharmaceutical dosage form (LAL-test); 7. Production of parenteral solutions in laboratory; 8. Production of ophthalmic preparations in laboratory; 9. Seminar project for pharmaceutical-technological operations in the production of immunobiological preparations;				

<table>
<tr><td></td><td colspan="5">10. Training for the final laboratory task;
11. Final laboratory task for preparing a solid dosage form formulation.</td></tr>
<tr><td>12.</td><td colspan="5">Study methods:
Lectures, seminars, exercises, individual assignments, collaborative lectures, methods of group discussions.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="3">7 ECTS x 30 hours = 210 hours (3+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="3">45+45+30+45+45</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>30 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>45 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>45 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="6">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Khar, R. K., Vyas, S. P.</td><td>Lachman/Lieberman's The Theory and Practice of Industrial Pharmacy (4th Edition)</td><td>CBS Publishers & Distributors Pvt Ltd</td><td>2015</td></tr>
<tr><td>2.</td><td>Sinko, P. J. (Editor)</td><td>Martin’s Physical Pharmacy and Pharmaceutical Sciences (7th Edition)</td><td>Wolters Kluwer India Pvt Ltd</td><td>2020</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Allen, L., McPherson, T. B.</td><td>Ansel’s Pharmaceutical Dosage Forms and Drug Delivery Systems (12th Edition)</td><td>Lippincott Williams & Wilkins</td><td>2021</td></tr>
</table>

		2.	Gibson, M. (Editor)	*Pharmaceutical Preformulation and Formulation: A Practical Guide from Candidate Drug Selection to Commercial Dosage Form (2nd Edition)*	CRC Press	2009

<table>
<tr><td colspan="2">Appendix 3
No. 32</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="5">CLINICAL BIOCHEMISTRY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="5">3FMN195025</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td colspan="2">Fourth year / Seventh semester</td><td>7.</td><td>Number of ECTS</td><td>5</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="5">Adj. Ass. Prof. Dr.sc. Ljubica Adji Andov</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="5">Enrolled in seventh semester of studies</td></tr>
<tr><td>10.</td><td colspan="6">Aims of the study program (competences):
– Gaining knowledge about different methods and techniques used for clinical biochemistry parameter determination;
– Organization of all laboratory phases and gaining knowledge about several medical disorders and how biochemical parameters and laboratory methods are used for the investigation, diagnosis and management of patients;
– Developing a core knowledge and understanding of clinical analysis of body fluids and other biological material to aid the diagnosis, therapy and monitoring of diseases, as well as interpretation of analytical results to other healthcare professionals.</td></tr>
<tr><td>11.</td><td colspan="6">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
Introduction to clinical biochemistry and gaining knowledge for organizing all phases in clinical biochemistry laboratories; Biochemical methods and tests for investigation, diagnosis and management of Diabetes mellitus; Biochemical methods and tests for investigation, diagnosis and management of dyslipidemia; Quality control in biochemical laboratories; Proteins: diagnostic significance and methods for their determination; Breakdown products: diagnostic significance and methods for their determination; Fundamentals of clinical enzymology: diagnostic significance of some important enzymes; Electrolytes: calcium, magnesium and phosphor; Iron, TIBC, transferrin and ferritin: diagnostic importance and methods for their determination; Immunochemical methods.
Practical part:
Types of blood drawing and blood drawing steps; Pipetting techniques; Photometric analysis and centrifugation; Determination of serum glucose concentration with GOD-PAP and method with hexokinase; Total plasma cholesterol and triglycerides determination; Plasma HDL and LDL cholesterol determination; Serum total protein and albumin determination; Urea and creatinine in serum and urine determination; AST and ALT activity in serum determination; Amylase activity in serum and urine determination; Sodium and potassium concentration in serum and urine determination; Serum iron and TIBC determination; Cortisol determination with WIA method; Practice exam.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Theoretical</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">5 ECTS x 30 hours = 150 hours (2+2)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">30+30+15+30+45</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td colspan="2">Lectures – theory</td><td>30 hours</td></tr>
<tr><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td>30 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td>15 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td>30 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td>45 hours</td></tr>
<tr><td>17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
</table>

<table>
<tr><td rowspan="4"></td><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="2">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="2">Self-evaluation</td></tr>
<tr><td rowspan="6">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="4">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Murphy, M., Srivastava, R., Deans, K.</td><td>Clinical biochemistry (7th Edition)</td><td>Elsevier</td><td>2023</td></tr>
<tr><td>2.</td><td>Burtis, C. A., Ashwood, E. R., Bruns, D. E.</td><td>Tietz Fundamentals of Clinical Chemistry (6th Edition)</td><td>Saunders</td><td>2007</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="4">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td colspan="4">Research papers in the field of clinical biochemistry</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 33</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">DRUG AND MEDICINAL PRODUCT ANALYSIS</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN195125</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Fourth year / Seventh semester</td><td>7.</td><td>Number of ECTS</td><td>7</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Ass. Prof. Dr.sc. Ivana Mitrevska</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in seventh semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
The lectures and the individual laboratory training of Drug and Medicinal Product Analysis are aimed at providing the student with the knowledge and the practice of chemical and instrumental methods for the identification of substances reported in European Pharmacopoeia monographs, improving his critical skills in approaching analytical challenges in the pharmaceutical field. The students will be able to deal with various advanced instrumental techniques for identification, characterization, and quantification of drugs.
The study program enhances the learners' awareness of regulatory and good manufacturing requirements in the Drug and Medicinal Product industries and introduces students to how scientists work and communicate.
The study program objective is to demonstrate the place and importance of quality control of medicines, to discover the reference works and international standards, to take a practical approach to the analytical techniques applied to medicines during their life cycle, to finally be able to propose the quality control of a pharmaceutical form (raw materials and finished products).
It provides a broad introduction to the drug and medicinal products industry, with an overview of manufacturing practices and environmental considerations. Students also learn about various methods of formulating medicines.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. Objectives and goals of modern pharmaceutical analysis: an overview;
2. Combinatorial chemistry and solid-state analysis;
3. Degradation and impurity analysis for pharmaceutical drug candidates;
4. Pre-formulation (physicochemical parameters & excipient compatibility) tests;
5. Solid dosage form analysis;
6. Parenteral dosage forms;
7. New drug delivery systems;
8. Compendial testing;
9. Forced degradation studies and characterization of degradation products.
Practical part:
1. Interpretation of regulatory considerations and compliance with main focus on International Conference on Harmonization (ICH), European Directorate for the Quality of Medicines (EDQM) and regulatory authorities in the United States (FDA);
2. Interpretation of the properties associated with the molecular level (examination of UV/VIS spectroscopy), properties associated with the particulate level (examination of microscopy) and properties associated with the bulk level (examination of particle size distribution);
3. Examination of LC-MS methods that are widely used in analysis and characterization of degradation impurities;</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">4. Interpretation of an analytical techniques and instruments for pre-formulation studies, in-depth examination of thermal methods, Fourier transform IR (FTIR), NIR, Raman spectroscopy;
5. Identification of raw materials with NIR method according to European Pharmacopoeia monograph;
6. Interpretation of microbiological testing of parenteral formulations;
7. Interpretation of in vitro transport experiments using heat-stripped human epidermis mounted in Franz diffusion chambers;
8. Interpretation of a compendial testing for formulated products and active ingredients;
9. Examination of thermal degradation on solid dosage form and characterization of unknown impurity.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, practice, individual assignments, and group discussions.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">7 ECTS x 30 hours = 210 hours (3+3)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">45+45+0+60+60</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">0 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">60 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">60 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td colspan="2">5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td colspan="2">6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td colspan="2">7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td colspan="2">8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td colspan="2">9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td colspan="2">10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="4">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>European Pharmacopoeia Commission</td><td>European Pharmacopoeia (Ph. Eur.)</td><td>Council of Europe</td><td>Current issue</td></tr>
<tr><td>2.</td><td>The International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use</td><td>ICH Guidelines</td><td>European Medicines Agency (EMA)</td><td>Current issues</td></tr>
</table>

		3.	Ahuja, S., Scypinski, S.	*Handbook of Modern Pharmaceutical Analysis (2nd Edition)*	Academic Press	2010
		4.	Watson, D. G.	*Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists (5th Edition)*	Elsevier	2020
		5.	Kar, A.	*Pharmaceutical Drug Analysis*	New Age International	2021
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	The British Pharmacopoeia Commission	*British Pharmacopoeia (BP)*	Medicines & Healthcare Products Regulatory Agency of the United Kingdom	Current issue
		2.	The United States Pharmacopeial Convention	*United States Pharmacopoeia (USP)*	The United States Pharmacopeial Convention	Current issue
		3.	Pedersen-Bjergaard, S., Gammelgaard, B., Halvorsen, T. G.	*Introduction to Pharmaceutical Analytical Chemistry (2nd Edition)*	Wiley	2019
		4.	Hansen, S. H.	*Introduction to Pharmaceutical Chemical Analysis (1st Edition)*	Wiley	2011
		5.	Skoog, D., West, D., Holler, F., Crouch, S.	*Fundamentals of Analytical Chemistry (10th Edition)*	Cengage Learning	2021
		6.	Konieczka, P.	*Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach (2nd Edition)*	CRC Press	2018
		7.	Rodríguez-Pérez, J.	*Quality Culture in the Pharmaceutical Industry: Implementing a Behavior-based Quality and Compliance Culture*	Business Excellence Consulting	2021
		8.	Bunn, G. P.	*Good Manufacturing Practices for Pharmaceuticals (7th Edition)*	CRC Press	2019

Appendix 3 No. 34		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**DRUG METABOLISM**			
2.	Code	3FMN195225			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Fourth year / Seventh semester	7.	Number of ECTS	5
8.	Professor	Assoc. Prof. Dr.sc. Darinka Gjorgieva Ackova			
9.	Pre-conditions for course registration	Enrolled in seventh semester of studies			
10.	**Aims of the study program (competences):** The course provides students with the acquisition of theoretical and practical knowledge in the field of drug metabolism and biochemical modifications with the participation of specialized enzyme systems. Special attention has been paid to understanding and defining the potential toxicity of drugs and enzyme-mediated detoxification mechanisms, the activation and deactivation of drugs, drug-drug interactions and genetic polymorphisms important for determining the duration and intensity of the pharmacological effect of drugs. Possibilities of applying metabolic principles in the development of modern therapies are also discussed.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. Introduction – chemical and enzymatic aspects of metabolism; 2. Basic principles of metabolism of xenobiotics; 3. Phase I of drug metabolism; 4. Reaction of hydrolysis, reduction and oxidation; 5. Cytochrome P450 (CYP enzymes); 6. Induction and inhibition of CYP enzymes. Xenosensors; 7. Enzyme induction/inhibition and chemical carcinogenesis; 8. Phase II of drug metabolism – Conjugation reactions (glucuronidation, methylation, sulfation, acetylation, conjugation with glutathione, conjugation with amino acids); 9. Pharmacogenetics and individualized pharmacotherapy; 10. Membrane transporters/carriers and drug response; 11. Drug interactions at the level of drug metabolism. *Practical part:* 1. Introduction; 2. Role of the physicochemical properties od drugs for their metabolism; 3. Protein binding of drugs in plasma; 4. *In vitro* techniques for examining drug metabolism and drug metabolites; 5. *In vivo* techniques for examining drug metabolism and drug metabolites; 6. Preparation of samples for examination of drug metabolism; 7. Specific bioanalytical methods for examining drug metabolism and drug metabolites; 8. Immuno-tests for examination of drug metabolism; 9. Qualitative and quantitative assessment of drug metabolites; 10. Methods for determining metabolizing phenotype (acetylation, CYP enzymes).				
12.	**Study methods:** Lectures, theoretical and laboratory exercises, project assignments, consultations. Laboratory exercises are performed in small groups of up to 10 students.				
13.	Total amount of time available	5 ECTS x 30 hours = 150 hours (2+2)			
14.	Distribution of tasks	30+30+15+30+45			

15.	Types of learning/teaching activities	15.1.	Lectures – theory	30 hours
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours
16.	Other types of activities	16.1.	Projects	15 hours
		16.2.	Individual tasks	30 hours
		16.3.	Home study – tasks	45 hours
17.	Evaluation / assessment methods			
	17.1.	Tests		40 points
	17.2.	Individual tasks / project (presentation: written and oral)		10 points
	17.3.	Activity and participation		20 points
	17.4.	Final exam		30 points
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)
			51 – 60 points	6 (six) (E)
			61 – 70 points	7 (seven) (D)
			71 – 80 points	8 (eight) (C)
			81 – 90 points	9 (nine) (B)
			91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.	
20.	Language of the study program		English	
21.	Quality assurance methods of the teaching process		Self-evaluation	

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	Pearson, P. G., Wienkers, L. C.	*Handbook of drug metabolism (3rd Edition)*	CRC Press	2019
2.	Coleman, M. D. (Editor)	*Human drug metabolism (2nd Edition)*	John Wiley & Sons Ltd	2010
3.	Gjorgieva Ackova, D., Janevik-Ivanovska, E.	*Drug metabolism (Метаболизам на лекови)* http://eprints.ugd.edu.mk/id/eprint/21243	Goce Delcev University, Stip	2018

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Evans, G. (Editor)	*A handbook of bioanalysis and drug metabolism*	CRC Press	2004
2.	Zhang, D., Zhu, M., Griffith Humphreys, W. G.	*Drug metabolism in drug design and development*	John Wiley & Sons Ltd	2008
3.	Ionescu, C., Caira, M. R.	*Drug metabolism – Current concepts*	Springer	2005

<table>
<tr><td colspan="2">Appendix 3
No. 35</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">BROMATOLOGY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN195325</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Fourth year / Seventh semester</td><td>7.</td><td>Number of ECTS</td><td>6</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Assoc. Prof. Dr.sc. Katarina Smilkov</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in seventh semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
– Acquire foundational knowledge in bromatology, including the classification and compositional analysis of food products and drinking water;
– Develop familiarity with analytical methodologies employed in the assessment of the quality and safety of food products and drinking water, and their practical applications;
– Understand the role and responsibilities of pharmacists in the evaluation and analysis of food products and drinking water to ensure public health safety.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. History of Bromatology: definition and objectives. Brief overview of the historical development of bromatology, including its definition and primary aims;
2. Definition and classification of nutrients. Comprehensive definition and categorization of nutrients;
3. Energy value of food. Analysis of the caloric and energy content of various food products;
4. Principles of rational human nutrition. Foundational principles of balanced and evidence-based human nutrition;
5. Quality and health safety of drinking water. Examination of water quality parameters and the safety standards for potable water;
6. Carbohydrates: structure, classification, and nutritional role. Analysis of carbohydrate-containing food products and their quality. Role of carbohydrates as essential macronutrients in human nutrition;
7. Lipids: structure, classification, and nutritional role. Structural composition and classification of lipids. Evaluation of lipid-containing food products and their quality. Role of lipids as macronutrients, with a focus on fatty acids and their nutritional significance;
8. Proteins: structure, classification, and nutritional role. Examination of protein-rich food products such as meat, milk, dairy products, eggs, and fish, along with their quality. Importance of proteins as essential macronutrients in human nutrition. Role of amino acids and their significance in metabolic processes and overall nutrition;
9. Micronutrients: vitamins and minerals. Classification of vitamins into liposoluble and hydrosoluble types, with emphasis on their roles as vital micronutrients. Overview of mineral substances, including macroelements and trace elements (oligoelements), and their critical importance in maintaining health;
10. Food additives and health considerations. Analysis of the types of food additives, their functional roles, and potential health implications;
11. Genetically Modified Foods. Definition and evaluation of genetically modified foods and their health and safety aspects;
12. Health aspects of food contamination. Examination of food contamination by microbiological, chemical, and radiological agents, and their impact on public health;</td></tr>
</table>

<table>
<tr><td></td><td colspan="5">13. Bioactive components in food. Analysis of bioactive compounds in food products and their significance in promoting health and preventing diseases.
Practical part:
1. Energy value of food and composition of dietary diet: Assessment of the caloric content and energy balance of food, alongside the nutritional composition of a daily meal;
2. Determination of water content in food products: Analytical techniques for quantifying water content in food products, with implications for quality and preservation;
3. Analysis and health safety of drinking water: Comprehensive analysis of drinking water, focusing on quality control parameters and compliance with health safety standards;
4. Protein analysis in food products and quality assessment: Evaluation of protein content in food products, including methods of analysis and quality assessment;
5. Fat analysis in food products and quality assessment: Analytical approaches to quantifying and assessing the quality of fats in food products;
6. Carbohydrate analysis in food products and quality assessment: Methods for determining carbohydrate content in food products, with an emphasis on quality evaluation;
7. Wine analysis: Chemical and sensory analysis of wine, including quality control and safety assessments;
8. Analysis of vitamins and minerals in food products: Quantitative and qualitative analysis of vitamins and minerals, evaluating their presence and bioavailability in food products;
9. Food additives: Examination of food additives, including their identification, functional roles, and potential health impacts.</td></tr>
<tr><td>12.</td><td colspan="5">Study methods:
Lectures, theoretical and practical exercises, consultations, self-based learning, additional preparations for exams and tests.
Practice: Laboratory exercises in small groups of 10 students, auditorial exercises.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="3">6 ECTS x 30 hours = 180 hours (3+2)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="3">45+30+0+45+60</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>0 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>45 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>60 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="3">English</td></tr>
</table>

<table>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="5">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Smilkov, K.</td><td>Authorized lectures</td><td>Goce Delcev University, Stip</td><td>2024</td></tr>
<tr><td>2.</td><td>Nielsen, S. S. (Editor)</td><td>Food Analysis (5th Edition)</td><td>Springer International Publishing AG</td><td>2017</td></tr>
<tr><td>3.</td><td>Belitz, H. D., Grosch, W., Schieberle, P.</td><td>Food Chemistry (4th Edition, revised and extended)</td><td>Springer – Verlag Berlin, Heidelberg</td><td>2009</td></tr>
<tr><td>4.</td><td>Nielsen, S. S.</td><td>Food Analysis Laboratory Manual (3rd Edition)</td><td>Springer International Publishing AG</td><td>2017</td></tr>
<tr><td rowspan="4">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Hurst, W. J. (Editor)</td><td>Methods of Analysis for Functional Foods and Nutraceuticals (2nd Edition)</td><td>CRC Press</td><td>2008</td></tr>
<tr><td>2.</td><td>Pearson, D.</td><td>Laboratory techniques in food analysis</td><td>National College of Food Technology, University of Reading</td><td>2001</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 36</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">ADVANCED DRUG AND MEDICINAL PRODUCT ANALYSIS</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN195425</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Fourth year / Eighth semester</td><td>7.</td><td>Number of ECTS</td><td>7</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Ass. Prof. Dr.sc. Ivana Mitrevska</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in eighth semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
The study program is a problem, lab-based subject that mimics operations within a pharmaceutical/biopharmaceutical company. Students work in teams to analyze pharmaceutical components using international pharmacopoeias, as well as creating all relevant documentation (batch records, SOPs, quality specifications, certificates of analysis). Another aspect involves examining dissolution profiles of a range of medicinal product formulations. The students will learn how to manage and solve problems concerning qualitative drug analysis and the quality control of compounds of pharmaceutical interest and the report and discuss the results.
This study program seeks to enhance the learner’s knowledge of working within regulated scientific environments with a focus on fundamental concepts of quality assurance. Validation of methods are examined and detailed to ensure compliance with the regulatory authorities such as ICH, EMA and FDA.
One of the main objectives of the study program is to deliver a wide range of experimental-focused analytical skills in modern laboratory settings. The program also aims to equip the graduate to pursue a career as an analytical scientist employed in the pharmaceutical and chemical sectors or to prepare the graduate to embark on further postgraduate research studies across the pharmaceutical and chemical sciences. Through successfully completing this program, the learners will acquire the competence to excel in the laboratory as an analytical scientist and facilitate career progression in this rewarding and multinational, industry-oriented field.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. Analytical method development through Quality by Design (QbD);
2. Setting specifications at different stages of drug development;
3. Validation of pharmaceutical test methods;
4. Stability studies (accelerated, intermediate and long-term stability testing of formulations);
5. Analytical methodology transfer;
6. Pharmaceutical analysis documentation;
7. An innovative separation platform;
8. Predictive in vitro dissolution tools: application during formulation development;
9. Quality control in the pharmaceutical industry.
Practical part:
1. Interpretation of analytical DoE approach of tests for organic synthetic process impurities, inorganic impurities, degradation products, residual solvents, and container extractables; tests of various physicochemical properties, chiral purity, water content, content uniformity, and antioxidant and antimicrobial preservative content; microbial tests; dissolution/disintegration tests; hardness/friability tests; and tests for particle size and polymorphic form;</td></tr>
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<tr><td></td><td colspan="6">2. Statistical concepts employed in setting specifications and their relationship to product quality control include accidental and systemic errors, frequency distributions, measures of dispersion, standard deviations, standard errors, and sampling plans;
3. Determination of method specificity to ensure “peak purity” on the main compound to be determined, confirm that no related compound or product ingredient coelutes and interferes with the measurement of the assayed compound;
4. Evaluation and interpretation of the results obtained during stability testing of drug products according to ICH Q1A;
5. Analysis of results/statistical packages for a drug product potency assay transferred to four sites simultaneously;
6. Interpretation of a variety of analytical reports during product life cycle of the process consists of sequential phases and milestones;
7. Interpretation of separation of HSV PCR-positive and PCR-negative CSF specimens by microchip electrophoresis;
8. Interpretation of alternative multivariate statistical approach for in vivo-in vitro similarity testing on conventional oral solid dosage form;
9. Interpretation of robust quality control measures throughout the manufacturing process, conduct through product testing and analysis, adhere to Good Manufacturing Practices (GMP) standards and data integrity. Role and responsibilities of qualified persons according to EudraLex Annex 16 (Certification by a Qualified Person and Batch Release).</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, practice, individual assignments, and group discussions.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">7 ECTS x 30 hours = 210 hours (3+3)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">45+45+0+60+60</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">0 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">60 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">60 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td colspan="2">5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td colspan="2">6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td colspan="2">7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td colspan="2">8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td colspan="2">9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td colspan="2">10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="3">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="2">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
</table>

		1.	European Pharmacopoeia Commission	*European Pharmacopoeia (Ph. Eur.)*	Council of Europe	Current issue
		2.	The International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use	*ICH Guidelines*	European Medicines Agency (EMA)	Current issues
		3.	Ahuja, S., Scypinski, S.	*Handbook of Modern Pharmaceutical Analysis (2nd Edition)*	Academic Press	2010
		4.	Watson, D. G.	*Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists (5th Edition)*	Elsevier	2020
		5.	Kar, A.	*Pharmaceutical Drug Analysis*	New Age International	2021
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	The British Pharmacopoeia Commission	*British Pharmacopoeia (BP)*	Medicines & Healthcare Products Regulatory Agency of the United Kingdom	Current issue
		2.	The United States Pharmacopeial Convention	*United States Pharmacopoeia (USP)*	The United States Pharmacopeial Convention	Current issue
		3.	Pedersen-Bjergaard, S., Gammelgaard, B., Halvorsen, T. G.	*Introduction to Pharmaceutical Analytical Chemistry (2nd Edition)*	Wiley	2019
		4.	Hansen, S. H.	*Introduction to Pharmaceutical Chemical Analysis (1st Edition)*	Wiley	2011
		5.	Skoog, D., West, D., Holler, F., Crouch, S.	*Fundamentals of Analytical Chemistry (10th Edition)*	Cengage Learning	2021
		6.	Konieczka, P.	*Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach (2nd Edition)*	CRC Press	2018

		7.	Rodríguez-Pérez, J.	*Quality Culture in the Pharmaceutical Industry: Implementing a Behavior-based Quality and Compliance Culture*	Business Excellence Consulting	2021
		8.	Bunn, G. P.	*Good Manufacturing Practices for Pharmaceuticals (7th Edition)*	CRC Press	2019

Appendix 3 No. 37		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**PHARMACEUTICAL TOXICOLOGY**			
2.	Code	3FMN195525			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Fourth year / Eighth semester	7.	Number of ECTS	7
8.	Professor	Assoc. Prof. Dr.sc. Darinka Gjorgieva Ackova			
9.	Pre-conditions for course registration	Enrolled in eighth semester of studies			
10.	**Aims of the study program (competences):** Pharmaceutical toxicology studies the toxic or xenobiotic-related adverse effects of chemicals (for instance, drugs 'possessing therapeutic values') when living beings are exposed to it. The course introduces students to the field of toxicology as a science, they acquire knowledge about toxins and toxicants, mechanisms of toxicity, and the chemical structure-toxicity relationship, as well as methods for the detection of toxic agents in various samples. Toxicology studies are carried out on all substances intended to be used in a variety of applications to ensure safety. With the focus on different groups with synthetic or natural origin, the most important safety issues of xenobiotics are covered here.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. General toxicology. Introduction; 2. Toxic response from different organs. Systemic toxicology; 3. Toxic elements – metals, metalloids, non-metals; 4. Toxic inorganic compounds. Organometals and organo-metalloids; 5. Toxic organic compounds – hydrocarbons; 6. Toxic organic oxygen compounds; 7. Toxic organic nitrogen compounds; 8. Toxic organic halogen compounds (organo-halides); 9. Toxic organic sulfur compounds; 10. Toxic organic phosphorus compounds; 11. Toxic compounds of natural origin; 12. Analysis of toxic substances in different samples. *Practical part:* 1. Introduction to the analytical toxicology laboratory; 2. Clinical aspects of analytical toxicology; 3. Risk assessment through examples; 4. Taking and processing samples for analysis; 5. Qualitative analysis of selected xenobiotics using colored tests and spot-analysis; 6. Toxicity of organic solvents and their derivatives: Spectrophotometric determination of phenol with 4-aminoantipyrine; Semiquantitative determination of phenol in urine; 7. Toxicity of organic compounds / drugs: Spectrophotometric determination of acetylsalicylic acid and other drugs; HPLC, GC tests for analysis; 8. Toxicity of organic compounds: TLC for identification of analgesics; 9. Toxicity of metals: Spectrophotometric determination of metals (Cu^{2+}, Ni^{2+}, Cr^{6+} through complexation) and ICP analysis; 10. Spectrophotometric determination of nitrites in water (Griess method); 11. TLC for identification of toxic substances of natural origin (alkaloids); 12. *In vitro* methodologies (NAM's) for toxicity testing.				
12.	**Study methods:**				

	Lectures, theoretical and laboratory exercises, project assignments, consultations. Laboratory exercises are performed in small groups of up to 10 students.				
13.	Total amount of time available		7 ECTS x 30 hours = 210 hours (3+3)		
14.	Distribution of tasks		45+45+15+30+75		
15.	Types of learning/teaching activities	15.1.	Lectures – theory	45 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	45 hours	
16.	Other types of activities	16.1.	Projects	15 hours	
		16.2.	Individual tasks	30 hours	
		16.3.	Home study – tasks	75 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	
	17.2.	Individual tasks / project (presentation: written and oral)		10 points	
	17.3.	Activity and participation		20 points	
	17.4.	Final exam		30 points	
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)	
			51 – 60 points	6 (six) (E)	
			61 – 70 points	7 (seven) (D)	
			71 – 80 points	8 (eight) (C)	
			81 – 90 points	9 (nine) (B)	
			91 – 100 points	10 (ten) (A)	
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.		
20.	Language of the study program		English		
21.	Quality assurance methods of the teaching process		Self-evaluation		

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	Klaassen, C. D. (Editor)	*Casarett & Doull's Toxicology: The Basic Science of Poisons (7th Edition)*	McGraw Hill	2008
2.	Pena-Fernandez, A., Evans, M. D., Cooke, M. S.	*Toxicology for the Health and Pharmaceutical Sciences*	CRC Press	2022
3.	Manahan, S. E.	*Toxicological chemistry and biochemistry (3rd Edition)*	Lewis Publishers	2003
4.	Gjorgieva Ackova, D.	*Toxicological chemistry (Токсиколошка хемија)* https://e-lib.ugd.edu.mk/1162	Goce Delcev University, Stip	2023

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Mulder, G. J., Dencker, L.	*Pharmaceutical toxicology*	Pharmaceutical Press	2006

		2.	Gjorgieva Ackova, D.	*Toxicological and clinic-toxicological analysis: protocols for laboratory work (Токсиколошки и клиничко-токсиколошки анализи: протоколи за лабораториска работа)* https://eprints.ugd.edu.mk/22754/	Goce Delcev University, Stip	2019

<table>
<tr><td colspan="2">Appendix 3
No. 38</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">BIOPHARMACY AND PHARMACOKINETICS</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN195625</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Fourth year /
Eighth semester</td><td>7.</td><td>Number of
ECTS</td><td>7</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Assoc. Prof. Dr.sc. Katarina Smilkov
Adj. Ass. Prof. Dr.sc. Marija Atanasova Lazareva</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in eighth semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
– Understanding the biopharmaceutical principles underlying drug design, including factors that influence drug formulation and therapeutic efficacy;
– Deeper understanding of the LADME concept: factors influencing drug release, absorption, distribution, metabolism, and elimination;
– Understanding the pharmacokinetics of drugs administered in the body by different routes of administration, calculations and analysis of pharmacokinetic parameters, dosage regimen, and dose adjustment.
– Understanding bioavailability and bioequivalence, their significance in drug development and therapeutic equivalence, and their assessment.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. Introduction to Biopharmacy and pharmacokinetics;
2. LADME concept: Drug release from dosage forms, kinetics and key factors influencing release; Drug absorption, mechanisms, kinetics and factors influencing the absorption; Drug distribution, mechanism, kinetics and factors influencing the distribution; Drug metabolism, mechanism, kinetics and factors influencing the metabolism; Drug elimination: mechanism, kinetics and factors influencing the elimination process;
3. Compartmental pharmacokinetic analysis;
4. Pharmacokinetics of a single intravenous dose;
5. Pharmacokinetics of continuous intravenous infusion;
6. Pharmacokinetics of extravascular administration, with a focus on oral administration;
7. Pharmacokinetics of multiple-dose regimens (multiple intravenous bolus, intermittent intravenous infusion, multiple oral dose);
8. Non-compartmental analysis;
9. Non-linear pharmacokinetics;
10. Bioavailability and bioequivalence.
11. In vitro – in vivo correlation.
Practical part:
1. Mathematical fundamentals of pharmacokinetics;
2. Graphical representation in pharmacokinetics;
3. Protein binding study of a model drug;
4. Determination of solubility and dissolution rate of a model drug;
5. Simulation and calculation of plasma elimination after an intravenous bolus dose of a model drug;
6. Simulation and calculation of urine excretion after an intravenous bolus dose of a model drug;</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">7. Simulation of plasma elimination after an intravenous infusion and calculation of pharmacokinetic parameters of a model drug;
8. Determination of pharmacokinetic parameters of a model drug that follows the oral one compartment model;
9. Calculations of multiple-dosage regimens and dose adjustment of a model drug;
10. Determination and calculations of bioavailability.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures with large groups of students, individual assignments, group discussions, homework, home study and student seminars.
Theoretical and practical laboratory exercises with small groups of students, practice exam.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">7 ECTS x 30 hours = 210 hours (3+3)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">45+45+0+30+90</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">45 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">45 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">0 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">30 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">90 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td colspan="2">5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td colspan="2">6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td colspan="2">7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td colspan="2">8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td colspan="2">9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td colspan="2">10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="5">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Smilkov, K., Atanasova Lazareva, M.</td><td>Authorized lectures</td><td>Goce Delcev University, Stip</td><td>2024</td></tr>
<tr><td>2.</td><td>Shargel, L., Wu-Pong, S., Yu, A. B. C.</td><td>Applied Biopharmaceutics & Pharmacokinetics (7th Edition)</td><td>McGraw Hill</td><td>2016</td></tr>
<tr><td>3.</td><td>Rosenbaum, S. E. (Editor)</td><td>Basic pharmacokinetics and pharmacodynamics: an integrated textbook and computer simulations (2nd Edition)</td><td>John Wiley & Sons Ltd</td><td>2017</td></tr>
</table>

		4.	Taylor, K. M. G.	*Aulton's Pharmaceutics (6th Edition)*	Elsevier	2021
		5.	Steffansen, B., Brodin, B., Nielsen, C. U.	*Molecular biopharmaceutics*	Pharmaceutical Press	2010
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Gibaldi, M., Perrier, D.	*Pharmacokinetics*	Informa Healthcare, New York	2007
		2.	Cox Gad, S.	*Preclinical development*	Wiley	2008
		3.	Jambhekar, S. S., Breen, P. J.	*Basic pharmacokinetics*	Pharmaceutical Press	2009
		4.	Bhise, S. B., Dias, R. J., Dhawale, S. C., Mali, S. K. K.	*Laboratory manual of biopharmaceutics and pharmacokinetics*	Trinity Publishing House	2010

Appendix 3 No. 39		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**SOCIAL PHARMACY**			
2.	Code	3FMN195725			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Fourth year / Eighth semester	7.	Number of ECTS	5
8.	Professor	Assoc. Prof. Dr.sc. Elena Drakalska Sersemova			
9.	Pre-conditions for course registration	Enrolled in eighth semester of studies			
10.	**Aims of the study program (competences):** – To acquire knowledge of the legislation relevant to pharmaceutical practice and the structure of the pharmaceutical sector within the healthcare system of the Republic of North Macedonia; – To understand theoretical concepts and models significant to social pharmacy; – To gain insights into pharmaceutical polices and the role of the pharmacists within the healthcare sector and society.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Theoretical part:* 1. Pharmaceutical System – Introduction, functions, and stakeholders in the system; 2. Legal framework for the operation of the pharmaceutical system – pharmaceutical, healthcare, and economic legislation; 3. National Drug Policy; 4. Medicines as entities in the pharmaceutical sector – research, innovative drugs, Good Clinical Practice (GCP), ethical aspects, manufacturing, and market release; 5. Drug Supply – stages, management systems, planning, procurement, monitoring, and evaluation; 6. Management of systems for range and inventory in wholesale trade – Good Distribution Practice (GDP), parallel trade of medicines; 7. Drug Selection – Essential Medicines Lists; 8. Pharmaceutical Marketing – Post-marketing surveillance, pharmacovigilance, and materiovigilance; 9. Marketing of medicines – ethical principles, information, and advertising; 10. Drug pricing and Price formation; 11. Financial management of the Pharmaceutical System – financing, control, and health insurance; 12. Professional Associations of Pharmacists – ethical aspects, continuous education, and management of pharmaceutical personnel. *Practical part:* – Discussions and practical exercises on all 12 lecture topics.				
12.	**Study methods:** Lectures, interactive activities, seminars, and practical sessions.				
13.	Total amount of time available	5 ECTS x 30 hours = 150 hours (2+2)			
14.	Distribution of tasks	30+30+60+15+15			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours	
16.	Other types of activities	16.1.	Projects	60 hours	
		16.2.	Individual tasks	15 hours	
		16.3.	Home study – tasks	15 hours	

<table>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="2">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="2">Self-evaluation</td></tr>
<tr><td rowspan="8">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="4">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Luis, M., Tamparo, K.</td><td>Medical ethics and bioethics</td><td>Academic Press</td><td>2010</td></tr>
<tr><td>2.</td><td>Petrova, G.</td><td>Social Pharmacy and Pharmaceutical Legislation</td><td>Infopharma EOOD, Sofia</td><td>2010</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="4">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Werheimer, A. I., Smith, M. C.</td><td>Pharmacy Practice, Social and Behavioral Aspects (3rd Edition)</td><td>Williams & Wilkins</td><td>1998</td></tr>
<tr><td>2.</td><td>Lodhi, D., Golani, P.</td><td>A Practical Text Book of Social Pharmacy</td><td>S. Vikas & Company</td><td>2021</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 40</td><td colspan="4">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="4">PHARMACEUTICAL BIOTECHNOLOGY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="4">3FMN195825</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="4">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="4">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="4">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Fifth year /
Ninth semester</td><td>7.</td><td>Number of ECTS</td><td>5</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="4">Assoc. Prof. Dr.sc. Katarina Smilkov</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="4">Enrolled in ninth semester of studies</td></tr>
<tr><td>10.</td><td colspan="5">Aims of the study program (competences):
– Acquiring comprehensive knowledge of recombinant DNA technology and its applications in the design and development of protein-based therapeutic agents;
– Gaining an in-depth knowledge of gene expression systems and their utilization in pharmaceutical biotechnology for the production of therapeutic compounds;
– Understanding the biotechnological production process and quality control methods for pharmaceuticals produced through recombinant technology.</td></tr>
<tr><td>11.</td><td colspan="5">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
1. Introduction to Pharmaceutical biotechnology: brief historical timeline of the field and overview of the fundamental concepts and applications of biotechnology in the pharmaceutical industry;
2. Nucleic acids, proteins, and recombinant DNA technology;
3. Production of recombinant therapeutic proteins and processes involved in obtaining therapeutics proteins through recombinant technology;
4. Structure and protein synthesis: detailed study of protein structure and the biochemical processes underlying protein synthesis;
5. Natural sources of pharmacologically active substances and application of recombinant technology: investigation of natural sources for substances with pharmacological activity and their enhancement through recombinant technology;
6. Classes of therapeutic proteins produced by recombinant technology: cytokines, hormones, recombinant blood proteins, and therapeutic enzymes;
7. Production and characteristics of monoclonal antibodies: analysis of the production methods, structural characteristics, and applications of monoclonal antibodies;
8. Production and characteristics of vaccines: overview of biotechnological methods used in vaccine production and their functional properties;
9. Gene Therapy: overview of gene therapy techniques and their therapeutic applications;
10. Cell and Tissue-Based Therapies: overview of cell and tissue-based therapies in the context of biotechnology;
11. Core processes in biotechnological production and their characteristics: overview of the processes in upstream and downstream biopharmaceutical production;
12. Formulation of recombinant protein products: approaches and considerations in the formulation of recombinant protein-based therapeutic products;
13. Regulatory approval for biotechnologically produced drugs and biosimilars: overview of the approval process for medical use of biotechnologically produced drugs and biosimilars, including regulatory requirements.
Practical part:
1. Gene manipulation in recombinant DNA technology: exploration of gene manipulation techniques important to recombinant DNA technology, including their applications;</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">2. Polymerase Chain Reaction (PCR) characteristics: detailed examination of the principles and characteristics of PCR in amplifying DNA sequences;
3. Upstream Processing: focus on cell culturing techniques, cell counting, constructing cell growth curves, and assessing the influence of culture media on cell growth;
4. Downstream Processing: focus on methods for protein isolation, including the application of advanced techniques for purification;
5. Sample concentration techniques for concentrating samples and optimizing the recovery of recombinant proteins;
6. Determination of product potency and protein concentration: review of analytical methods for evaluating the potency and concentration of protein products;
7. Techniques for identifying impurities in recombinant proteins: advanced techniques for the detection and quantification of impurities in recombinant protein products;
8. Pyrogen testing in recombinant protein products: analytical approaches for detecting the presence of pyrogens in recombinant protein formulations;
9. Formulation of biologics (stabilization and lyophilization): focus on methods for stabilizing biologically-derived drugs, with focus on lyophilization (freeze-drying) techniques to ensure product integrity and shelf-life.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures, theoretical and practical exercises, consultations, self-based learning, additional preparations for exams and tests.
Laboratory exercises in small groups of 10 students. Auditorial exercises.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">5 ECTS x 30 hours = 150 hours (2+2)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">30+30+10+30+50</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>10 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>30 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>50 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="4">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Smilkov, K.</td><td>Authorized lectures</td><td>Goce Delcev University, Stip</td><td>2024</td></tr>
</table>

		2.	Gupta, V., Sengupta, M., Prakash, J., Tripathy, B. C.	*Basic and applied aspects of Biotechnology*	Springer	2017
		3.	Crommelin, D. J. A., Sindelar, R. D., Meibohm, B. (Editor)	*Pharmaceutical Biotechnology: Fundamentals and Application*	Springer	2013
		4.	Greensterin, B., Brook, D. A.	*Biological Therapeutics*	Pharmaceutical Press	2011
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Gutka, H. J., Yang, H., Kakar, S. (Editors)	*Biosimilars: regulatory, clinical and biopharmaceutical development*	AAPS / Springer	2018
		2.	Walsh, G.	*Pharmaceutical Biotechnology: Concepts and Applications*	John Wiley & Sons	2007
		3.	Cox Gad, S. (Editor)	*Handbook of Pharmaceutical Biotechnology*	Wiley	2007

<table>
<tr><td colspan="3">Appendix 3
No. 41</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Name of the course</td><td colspan="5">CLINICAL PHARMACY AND PHARMACOTHERAPY</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="5">3FMN195925</td></tr>
<tr><td>3.</td><td colspan="2">Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td colspan="2">Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td colspan="2">Fifth year /
Ninth semester</td><td>7.</td><td>Number of ECTS</td><td>5</td></tr>
<tr><td>8.</td><td colspan="2">Professor</td><td colspan="5">Full Prof. Dr.sc. Zorica Arsova Sarafinovska</td></tr>
<tr><td>9.</td><td colspan="2">Pre-conditions for course registration</td><td colspan="5">Enrolled in ninth semester of studies</td></tr>
<tr><td>10.</td><td colspan="7">Aims of the study program (competences):
The aim of the study program is to introduce students with clinical practice in the treatment of various diseases and conditions, with the principles of rational pharmacotherapy and pharmaceutical care. It is expected that after successful completion of the course, the student would be able to understand and differentiate the pathophysiology, clinical manifestations, clinical course and prognosis, investigations, pharmacological and non-pharmacological treatment; to compare the ratio of therapeutic efficacy/safety of individual drugs intended for the same condition/disease and to present evidence-based information to patients and healthcare professionals.</td></tr>
<tr><td>11.</td><td colspan="7">Content of the study program (applies both for theoretical and practical part):
Theoretical part:
Definition, etiology, pathology, epidemiology, clinical manifestations and treatment strategies of the most significant and common groups of diseases: lung diseases, kidney diseases, cardiovascular diseases, diseases of the gastrointestinal tract, liver diseases, neurological diseases, psychiatric diseases, endocrinological diseases (diabetes); most important groups of drugs used in the treatment of the studied diseases; practical application of individuals drugs; pharmacotherapy of vulnerable groups of patients.
Practical part:
Case studies to illustrate the topics covered in the theoretical part of the study program.</td></tr>
<tr><td>12.</td><td colspan="7">Study methods:
Lectures – theory; Tutorials (laboratory), seminars, teamwork.
Individual consultations with students and consultations in groups. Exercises in small groups of 10 students.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="4">5 ECTS x 30 hours = 150 hours (2+2)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="4">30+30+10+20+60</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td colspan="2">Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td colspan="2">10 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td colspan="2">20 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td colspan="2">60 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="3">18.</td><td colspan="3" rowspan="3">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
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<tr><td></td><td colspan="5"></td><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td></td><td colspan="5"></td><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td></td><td colspan="5"></td><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="5">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="5">Language of the study program</td><td colspan="2">English</td></tr>
<tr><td>21.</td><td colspan="5">Quality assurance methods of the teaching process</td><td colspan="2">Self-evaluation</td></tr>
<tr><td rowspan="8">22.</td><td colspan="7">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="6">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Walker, R., Whittlesea, R.</td><td>Clinical Pharmacy and Therapeutics (5th Edition)</td><td>Churchill Livingstone</td><td>2012</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="6">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Whittlesea, C., Hodson, K.</td><td>Clinical Pharmacy and Therapeutics (6th Edition)</td><td>Elsevier</td><td>2018</td></tr>
</table>

Appendix 3 No. 42			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**COMMUNITY PHARMACY AND PATIENT COMMUNICATION**			
2.	Code		3FMN196025			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Fifth year / Ninth semester	7.	Number of ECTS	4
8.	Professor		Assoc. Prof. Dr.sc. Biljana Lazarova			
9.	Pre-conditions for course registration		Enrolled in ninth semester of studies			
10.	**Aims of the study program (competences):** Acquiring knowledge in the field of pharmacy as a health service that includes selection, procurement, preparation, storage, compounding, dispensing of drugs and medical devices, as well as advising patients and health professionals on the safe, efficient and effective use of drugs.					
11.	**Content of the study program (applies both for theoretical and practical part):** – Legal regulation in pharmacy operations and standards for good pharmacy practice; – Pharmacy management; – Pharmacoinformatics in pharmacy practice; – Communication skills of the pharmacist; – Advising patients when making decisions about their therapy; – Pharmaceutical care in pharmacy practice.					
12.	**Study methods:** Lectures with large groups of students, individual assignments, group discussions, homework, home study and student seminars. Theoretical and practical exercises with small groups of students, practical exams.					
13.	Total amount of time available		4 ECTS x 30 hours = 120 hours (1+2)			
14.	Distribution of tasks		15+30+15+30+30			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	15 hours		
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	30 hours		
16.	Other types of activities	16.1.	Projects	15 hours		
		16.2.	Individual tasks	30 hours		
		16.3.	Home study – tasks	30 hours		
17.	Evaluation / assessment methods					
	17.1.	Tests		40 points		
	17.2.	Individual tasks / project (presentation: written and oral)		10 points		
	17.3.	Activity and participation		20 points		
	17.4.	Final exam		30 points		
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)		
			51 – 60 points	6 (six) (E)		
			61 – 70 points	7 (seven) (D)		
			71 – 80 points	8 (eight) (C)		
			81 – 90 points	9 (nine) (B)		
			91 – 100 points	10 (ten) (A)		
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.			
20.	Language of the study program		English			

<table>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="5">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Beardsley, R. S., Kimberlin, C. L., Tindall, W. N.</td><td>Communication Skills in Pharmacy Practice: A Practical Guide for Students and Practitioners</td><td>Lippincott Williams & Wilkins</td><td>2012</td></tr>
<tr><td>2.</td><td>WHO Team: Essential Medicines (EML), Health Product Policy and Standards (HPS), Medicines Selection, IP and Affordability (MIA), WHO Headquarters (HQ)</td><td>WHO Model List of Essentials Medicines (23rd list)</td><td>World Health Organization</td><td>2023</td></tr>
<tr><td>3.</td><td>International Pharmaceutical Federation, World Health Organization</td><td>Joint FIP/WHO Guidelines on Good Pharmacy Practice: Standards for quality of pharmacy</td><td>International Pharmaceutical Federation</td><td>2023</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Pharmaceutical Group of European Union</td><td>Pharmacy 2030: A Vision for Community Pharmacy in Europe</td><td>Pharmaceutical Group of European Union</td><td>2023</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 43</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="5">DRUG INFORMATION MANAGEMENT</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="5">3FMN196125</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td colspan="2">Fifth year /
Ninth semester</td><td>7.</td><td>Number of ECTS</td><td>4</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="5">Assoc. Prof. Dr.sc. Biljana Lazarova</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="5">Enrolled in ninth semester of studies</td></tr>
<tr><td>10.</td><td colspan="6">Aims of the study program (competences):
Providing students with information about medicines as the most fundamental obligation of pharmacists, as well as information about drugs that may be patient-specific or developed for a specific patient population. Such information is therapeutic guidelines, national quality initiatives, coordination of an adverse drug event reporting and analysis program, publication of an electronic newsletter or website update. The pharmacist can serve as a source of answers to questions related to the cost-effective choice of drugs and their use, drug policy decisions (drug benefits), selection of drug information resources or issues related to pharmaceutical practice. Increasing opportunities for drug information to evolve and expand with changes in the health care environment and with national efforts to expand access to care while reducing health care costs, with the rise of the self-care movement and the integration of new health information technologies. Increasing opportunities for drug information to grow in several different areas within the healthcare environment, such as healthcare management organizations, the pharmaceutical industry, medical and specialty healthcare clinics, scientific writing and medical communication companies, and insurance companies.</td></tr>
<tr><td>11.</td><td colspan="6">Content of the study program (applies both for theoretical and practical part):
– Drug information management focuses on the use and integration of data, information, knowledge, and technology involved in drug use processes to improve pharmacotherapy outcomes;
– The use of informatics in improving pharmaceutical care in primary and secondary healthcare;
– Drug information management as part of pharmaceutical practice for the delivery of drug therapy and reengineering of the drug use process;
– The two broad categories of information used in Drug information management and other domains of clinical informatics are patient-specific information and knowledge-based information;
– The importance of Drug information centers at the local and national level;
– Systematically modified approach to answering the questions.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures with large group of students, individual assignments, group discussions, homework, home study and student seminars. Theoretical and practical exercises with small groups of students, practical exam.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">4 ECTS x 30 hours = 120 hours (1+2)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">15+30+15+30+30</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td colspan="2">Lectures – theory</td><td colspan="2">15 hours</td></tr>
<tr><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td colspan="2">15 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td colspan="2">30 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td colspan="2">30 hours</td></tr>
</table>

<table>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="3">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="3">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="3">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="3">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="3">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="3">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="4">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="4">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Malone, P. M., Witt, B. A., Malone, M. J. Peterson, D. M.</td><td>Drug Information: A Guide for Pharmacists (7th Edition)</td><td>McGraw Hill</td><td>2018</td></tr>
<tr><td>2.</td><td>Neoh, C. F., Zainal, I. N. A., Hameed, M. Ab., Khan, T. M., Ming, L. C.</td><td>Development and Progress of Pharmacoinformatics in Pharmaceutical and Health Sciences</td><td>Journal of Young Pharmacists</td><td>2015</td></tr>
<tr><td>3.</td><td>Kier, K. L., Goldwire, M.</td><td>Drug Information Resources and Literature Review</td><td>American College of Clinical Pharmacy</td><td>2018</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td colspan="3">Appendix 3
No. 44</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Name of the course</td><td colspan="5">PROFESSIONAL PRACTICE –
HOSPITAL AND CLINICAL PHARMACY</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="5">3FMN196225</td></tr>
<tr><td>3.</td><td colspan="2">Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td colspan="2">Study program organizer
(department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td colspan="2">Fifth year /
Ninth semester</td><td>7.</td><td>Number of ECTS</td><td>10</td></tr>
<tr><td>8.</td><td colspan="2">Professor</td><td colspan="5">Assigned practice coordinator from the receiving institution</td></tr>
<tr><td>9.</td><td colspan="2">Pre-conditions for course registration</td><td colspan="5">Enrolled in ninth semester of studies</td></tr>
<tr><td>10.</td><td colspan="7">Aims of the study program (competences):
Acquisition of practical knowledge and skills in the domain of hospital pharmacy practice: organization of work in a hospital pharmacy and administrative tasks, familiarization with groups of medications and medical supplies used in hospital settings, storage conditions for specific categories of medications, the procedures for dispensing medications to clinical departments, and record-keeping.
Execution of sterilization procedures and aseptic techniques, as well as preparation of ex tempore magistral formulations intended for hospital treatment.</td></tr>
<tr><td>11.</td><td colspan="7">Content of the study program:
– The role of the hospital pharmacist: providing advice od medication administration, familiarization with medications used in hospital settings, their pharmacotherapeutic classification, and researching their indications, contraindications, and potential interactions;
– Familiarization with types of medical materials dispensed in hospital settings and the essential medicines list for hospital pharmacies;
– Performing sterilization procedures, aseptic work in the hospital pharmacy, and preparing magistral formulations intended for hospital treatment;
– Administrative management of a hospital pharmacy.</td></tr>
<tr><td>12.</td><td colspan="7">Study methods:
Theoretical, practical, and self-directed approaches tailored to the field of hospital pharmacy.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">10 ECTS x 30 hours = 300 hours (15 weeks)
15 weeks (75 days) x 20 hours = 300 hours</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">30+30+0+240+0</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">0 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">240 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">0 hours</td></tr>
<tr><td rowspan="3">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Evaluation criteria</td><td>Completed</td></tr>
<tr><td colspan="3"></td><td>Not completed</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
</table>

<table>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">Completed 300 hours and a confirmed practice booklet is mandatory to complete this course.
No final exam needed.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="14">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="7">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Malone, P. M., Witt, B. A., Malone, M. J., Peterson, D. M.</td><td>Drug Information: A Guide for Pharmacists (7th Edition)</td><td>McGraw Hill</td><td>2018</td></tr>
<tr><td>2.</td><td>Embrey, M. (Editor)</td><td>Managing Access to Medicines and Health Technologies (Chapter 45. Hospital Pharmacy Management)</td><td>Management Sciences for Health</td><td>2012</td></tr>
<tr><td>3.</td><td colspan="4">https://www.ema.europa.eu/en/medicines</td></tr>
<tr><td>4.</td><td colspan="4">https://lekovi.zdravstvo.gov.mk/drugregister/overview</td></tr>
<tr><td>5.</td><td colspan="4">https://malmed.gov.mk/</td></tr>
<tr><td>6.</td><td colspan="4">https://eahp.eu/hospital-pharmacy-practice/european-statements-hospital-pharmacy/</td></tr>
<tr><td rowspan="6">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Whalley, B., Fletcher, K. E., Weston, S., Howard, R. L., Rawlinson, C. F. (Editors)</td><td>Foundation in Pharmacy Practice</td><td>Pharmaceutical Press</td><td>2008</td></tr>
<tr><td>2.</td><td>Beardsley, R. S., Skrabal, M. Z., Tindall, W. N.</td><td>Communication Skills in Pharmacy Practice: A Practical Guide for Students and Practitioners (7th Edition)</td><td>Lippincott Williams & Wilkins</td><td>2012</td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 45</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="5">PROFESSIONAL PRACTICE – COMMUNITY PHARMACY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="5">3FMN196325</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td colspan="2">Fifth year /
Tenth semester</td><td>7.</td><td>Number of ECTS</td><td>20</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="5">Assigned practice coordinator from the receiving institution</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="5">Enrolled in tenth semester of studies</td></tr>
<tr><td>10.</td><td colspan="6">Aims of the study program (competences):
Acquisition of practical knowledge and skills in the field of pharmacy practice: keeping, selection, procurement (ordering and receipt), handling shortages, storage and preservation, dispensing prescriptions, patient counseling, prescription processing, maintaining records for controlled substances, preparation of ex tempore magistral formulations, monitoring adverse drug reactions, detecting potential interactions in polypharmacy, and the pharmacist’s advisory role in the domains of cosmetics, dietary products, and supplements.</td></tr>
<tr><td>11.</td><td colspan="6">Content of the study program:
– Familiarization with the administrative operation of a pharmacy, maintaining mandatory documentation, understanding the legal regulations related to pharmacy practice, and using the information system for administrative work with the Health Insurance Fund;
– Familiarization with pharmacotherapeutic drug groups and the use of professional literature databases for pharmacotherapy, indications, contraindications, and interactions;
– Understanding the essential medicines list for community pharmacies;
– Introduction to the pharmacovigilance system;
– Familiarization with categories of medicines and medical devices, cosmetic products, dietary products, and supplements, including their reception, storage, and dispensing procedures;
– Understanding the processes for dispensing prescription and non-prescription (OTC) drugs;
– Preparation of ex tempore magistral medicines;
– Developing communication skills for patient interactions and providing professional advice.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Theoretical, practical, and self-directed approaches tailored to the field of community pharmacy.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">20 ECTS x 30 hours = 600 hours (15 weeks)
15 weeks (75 days) x 40 hours = 600 hours</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">30+270+0+300+0</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td colspan="2">Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">270 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td colspan="2">0 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td colspan="2">300 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td colspan="2">0 hours</td></tr>
<tr><td>17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
</table>

	17.1.	Evaluation criteria		Completed
				Not completed
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)
			51 – 60 points	6 (six) (E)
			61 – 70 points	7 (seven) (D)
			71 – 80 points	8 (eight) (C)
			81 – 90 points	9 (nine) (B)
			91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam		Completed 600 hours and a confirmed practice booklet is mandatory to complete this course. No final exam needed.	
20.	Language of the study program		English	
21.	Quality assurance methods of the teaching process		Self-evaluation	

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	Beardsley, R. S., Skrabal, M. Z., Tindall, W. N.	*Communication Skills in Pharmacy Practice: A Practical Guide for Students and Practitioners (7th Edition)*	Lippincott Williams & Wilkins	2012
2.	Malone, P. M., Witt, B. A., Malone, M. J., Peterson, D. M.	*Drug Information: A Guide for Pharmacists (7th Edition)*	McGraw Hill	2018
3.	Dua, K., Pabreja, K., Sharma, V. K.	*Community Pharmacy: Basic Principles and Concepts*	PharmaMed Press	2015
4.	https://www.ema.europa.eu/en/medicines			
5.	https://lekovi.zdravstvo.gov.mk/drugregister/overview			
6.	https://malmed.gov.mk/			

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Calomo, J. M.	*Teaching Management in a Community Pharmacy*	American Journal of Pharmaceutical Education	2006

Appendix 3 No. 46			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**GRADUATION THESIS**			
2.	Code		3FMN196425			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Fifth year / Tenth semester	7.	Number of ECTS	10
8.	Professor		Selected by the student from the teaching professors			
9.	Pre-conditions for course registration		Enrolled in tenth semester of studies			
10.	**Aims of the study program (competences):** – Independent execution of scientific research work under the supervision of a selected mentor; – Development of competencies for scientific research, including formulating an experimental/research hypothesis; – Conducting literature searches from relevant sources; – Critically evaluating obtained results; – Writing professional/scientific research papers; – Presenting research findings effectively.					
11.	**Content of the study program:** Completion of all phases of scientific research work, from the preliminary literature review and formulation of a research hypothesis (research objective) to the implementation of research (experiment), analysis of the obtained results, and presentation of the findings in the form of a written thesis, and a thesis defense. After conducting the research, the student prepares a thesis containing the following chapters: Introduction, Research Objective, Materials and Methods, Results and Discussion, Conclusion, and References. Once the thesis is completed and approved by the mentor, a public defense is scheduled. The public defense is conducted in front of committee composed of a chairperson, a first member, and a second member, who also serves as the mentor of the thesis. During the defense, the student presents the main aspects of the thesis in a concise format and then responds to questions posed by the committee members. After the defense, the committee deliberates and decides whether the thesis is accepted, assigning an appropriate grade.					
12.	**Study methods:** Working with a mentor, conducting literature searches, self-learning, practical work, scientific writing, and presenting the research in the form of a presentation.					
13.	Total amount of time available		10 ECTS x 30 hours = 300 hours			
14.	Distribution of tasks		30+30+0+200+40			
15.	Types of learning/teaching activities	15.1.	Lectures – theory		30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork		30 hours	
16.	Other types of activities	16.1.	Projects		0 hours	
		16.2.	Individual tasks		200 hours	
		16.3.	Home study – tasks		40 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			/	
	17.2.	Individual tasks / project (presentation: written and oral)			100 points	
	17.3.	Activity and participation			/	
	17.4.	Final exam			/	
18.	Assessment criteria (points / grade)		Up to 50 points		5 (five) (F)	
			51 – 60 points		6 (six) (E)	

<table>
<tr><td rowspan="4"></td><td colspan="3" rowspan="4"></td><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">Completed 300 hours of graduation work, completion of all necessary activities related to the study program and plagiarism check of the written paper.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="6">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="2">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td colspan="4">Literature selection according to the research topic.</td></tr>
<tr><td rowspan="2">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td></td><td></td><td></td><td></td></tr>
</table>

Appendix 3 No. 47			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**MACEDONIAN LANGUAGE FOR FOREIGN STUDENTS**			
2.	Code		4FF161125			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		First year / First semester	7.	Number of ECTS	4
8.	Professor		Ass. Prof. Dr.sc. Marija Grkova-Beader			
9.	Pre-conditions for course registration		Enrolled in first semester of studies			
10.	**Aims of the study program (competences):** Students get to know the Macedonian language and its development. They become familiar with the phonological-phonetic and morphological structure of the language. They are also introduced to the basic ways of word formation, proficiency in the Macedonian language in oral and written form. Students are introduced to basic vocabulary related to colors, physical appearance, hour weather, seasons, parts of the world, food, institutions, and so on. Students are introduced to the alphabet, present and future tense, the verb 'am', nouns, adjectives, their grammatical categories and more.					
11.	**Content of the study program (applies both for theoretical and practical part):** Alphabet – sounds and graphemes, numbers, present and future tense (affirmative, negative and interrogative), nouns – grammatical categories, adjectives, pronouns, short and long pronoun forms – imperative, prepositions. Introduction, flags, countries, nationalities, transport, household, days, months, hours, seasons, parts of the world, food, institutions, activities, clothes, music, sports, animals, everyday life, landmarks, etc.					
12.	**Study methods:** Interactive, group work, homework, individual work, lecture, discussion, cooperative learning techniques, individual assignments, independent study, making individual work, use of electronic learning in teaching and exercises.					
13.	Total amount of time available		4 ECTS x 30 hours = 120 hours (2+1)			
14.	Distribution of tasks		30+15+15+30+30			
15.	Types of learning/teaching activities	15.1.	Lectures – theory		30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork		15 hours	
16.	Other types of activities	16.1.	Projects		15 hours	
		16.2.	Individual tasks		30 hours	
		16.3.	Home study – tasks		30 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			40 points	
	17.2.	Individual tasks / project (presentation: written and oral)			10 points	
	17.3.	Activity and participation			20 points	
	17.4.	Final exam			30 points	
18.	Assessment criteria (points / grade)		Up to 50 points		5 (five) (F)	
			51 – 60 points		6 (six) (E)	
			61 – 70 points		7 (seven) (D)	
			71 – 80 points		8 (eight) (C)	
			81 – 90 points		9 (nine) (B)	
			91 – 100 points		10 (ten) (A)	

<table>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">Macedonian and English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="8">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="5">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Kusevska, M., Mitkovska, L.</td><td>Do you speak Macedonian? – Textbook</td><td>Prosvetno delo</td><td>2017</td></tr>
<tr><td>2.</td><td>Kusevska, M., Mitkovska, L.</td><td>Do you speak Macedonian? – Workbook</td><td>Prosvetno delo</td><td>2017</td></tr>
<tr><td>3.</td><td>Gochkova-Stojanovski, T., Panovska-Dimkova, I.</td><td>Bozhilak</td><td>Kultura</td><td>2015</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td colspan="3">Appendix 3
No. 48</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Name of the course</td><td colspan="5">ENGLISH FOR PHARMACISTS</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="5">4FF161225</td></tr>
<tr><td>3.</td><td colspan="2">Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td colspan="2">Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td colspan="2">First year /
First semester</td><td>7.</td><td>Number of ECTS</td><td>4</td></tr>
<tr><td>8.</td><td colspan="2">Professor</td><td colspan="5">Senior Lecturer Dragan Donev</td></tr>
<tr><td>9.</td><td colspan="2">Pre-conditions for course registration</td><td colspan="5">Enrolled in first semester of studies</td></tr>
<tr><td>10.</td><td colspan="7">Aims of the study program (competences):
The aim of the course is to enable students to supplement and expand their language knowledge, as well as to apply it in verbal situations in the field of pharmacy through the integral use of appropriate language.</td></tr>
<tr><td>11.</td><td colspan="7">Content of the study program (applies both for theoretical and practical part):
The Human Body; Review of Previous Lesson Material; The Locomotory System; Review of Previous Lesson Material; The Sensory System; Review of Previous Lesson Material; The Nervous System; Review of Previous Lesson Material; The Respiratory System; Review of Previous Lesson Material; Pharmacy Terminology; Project Presentation.</td></tr>
<tr><td>12.</td><td colspan="7">Study methods:
Seminars, discussion, cooperative learning techniques, independent learning, making individual work, use of electronic learning in teaching and exercises.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="4">4 ECTS x 30 hours = 120 hours (2+1)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="4">30+15+15+30+30</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td colspan="2">Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">15 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td colspan="2">15 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td colspan="2">30 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td colspan="2">30 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="2">22.</td><td colspan="6">Literature</td></tr>
<tr><td>22.1.</td><td colspan="5">Mandatory literature</td></tr>
</table>

		No.	Author	Title	Publisher	Year
		1.	Evans, V., Dooley, J.	*Upstream Elementary A2*	Express Publishing	2013
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.				

Appendix 3 No. 49		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**GERMAN LANGUAGE LEVEL A1.1**			
2.	Code	4FF161325			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	First year / First semester	7.	Number of ECTS	4
8.	Professor	Senior Lecturer Marica Tasevska			
9.	Pre-conditions for course registration	Enrolled in first semester of studies			
10.	**Aims of the study program (competences):** Students to be able to conduct short dialogues when meeting, greeting, to express opinions on everyday topics, to find an unknown city, to communicate with people from German-speaking countries, to shop in Germany, to make recommendations, to describe and express specific opinions, to get acquainted with the culture and civilization in the German-speaking countries, etc.				
11.	**Content of the study program (applies both for theoretical and practical part):** *Grammar*: verbs and conjugation of verbs (haben, sein, kommen, sprechen, fahren, schlafen, sehen …), question words (wer, wo, woher, wie), personal pronouns (accusative and dative), possessive pronouns (nominative and accusative), definite / indefinite article, separable verbs, adverbs in time (accusative and dative), question sentences, modal verbs (mögen, können, wollen, dürfen, sollen, müssen), perfect (past tense), imperative (ordering, adverbs of place, modality 'könnten, würden + infinitiv'), comparative and conjugative adjectives (viel, gern, gut), verbs with dative, conjunctions for independent sentences (und, oder, aber, denn), ordinal numbers. *Vocabulary*: words from the field: greeting, presentation, eating and drinking, weight measures, furniture, household appliances, numbers, colors, activities and leisure, weather, professions, human body parts, diagnosis and recommendations, landmarks of the city, transportation, fashion and clothing, more important holidays in the German-speaking countries, etc. *Speaking*: dialogues when meeting, first meeting, description of person, dialogues in the market, restaurant, description of an apartment or particular room, description of activities we undertake in our free time, description of a profession, description of a city that you visited and country, scheduling, rescheduling or cancellation of an appointment, description of a particular location, answering machine message, dialogues in shopping center, fashion magazine image description, sharing specialty opinions, greetings and phrases to celebrate holidays or festivities in German-speaking countries.				
12.	**Study methods:** Interactive method: group work, reports, homework, seminar papers, discussion, debate, cooperative studying techniques, individual tasks, simulation of extra-curricular educational activities, individual studying.				
13.	Total amount of time available	4 ECTS x 30 hours = 120 hours (2+1)			
14.	Distribution of tasks	30+15+15+30+30			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	15 hours	
16.	Other types of activities	16.1.	Projects	15 hours	
		16.2.	Individual tasks	30 hours	
		16.3.	Home study – tasks	30 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	

	17.2.	Individual tasks / project (presentation: written and oral)		10 points
	17.3.	Activity and participation		20 points
	17.4.	Final exam		30 points
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)
			51 – 60 points	6 (six) (E)
			61 – 70 points	7 (seven) (D)
			71 – 80 points	8 (eight) (C)
			81 – 90 points	9 (nine) (B)
			91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.	
20.	Language of the study program		German and English	
21.	Quality assurance methods of the teaching process		Self-evaluation	

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	Kerner, M., Hilpert, S., Reimann, M., Tomaszewski, A.	*Schritte International 1: Kursbuch und Arbeitsbuch*	Hueber Verlag	2006
2.	Jin, F., Voß, U.	*Grammatik aktiv: Üben, Hören, Sprechen*	Cornelsen	2018
3.	Grcheva, R., Rau, P.	*Large Macedonian-German dictionary, German-Macedonian dictionary*	Magor	2006

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	Gacov, D.	*German grammar*	National & University Library St. Clement of Ohrid	1995
2.	Evans, S., Pude, A., Sprecht, F.	*Menschen A1.2*	Hueber Verlag	2012
3.	Swerlowa, O.	*Grammatik & Konversation 1: Arbeitsblätter für den Deutschunterricht*	Langenscheidt	2013

<table>
<tr><td colspan="3">Appendix 3
No. 50</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Name of the course</td><td colspan="5">INDUSTRIAL PHARMACY</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="5">3FMN196825</td></tr>
<tr><td>3.</td><td colspan="2">Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td colspan="2">Study program organizer
(department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td colspan="2">Fourth year /
Eighth semester</td><td>7.</td><td>Number of ECTS</td><td>2</td></tr>
<tr><td>8.</td><td colspan="2">Professor</td><td colspan="5">Assoc. Prof. Dr.sc. Aleksandar Cvetkovski</td></tr>
<tr><td>9.</td><td colspan="2">Pre-conditions for course registration</td><td colspan="5">Enrolled in eighth semester of studies</td></tr>
<tr><td>10.</td><td colspan="7">Aims of the study program (competences):
Acquiring a knowledge in the quality assurance systems in the production and distribution of medicines, the basic principles for formulation and development of pharmaceutical dosage forms (PDF), the methodologies of transferring the procedure for the production of PDF from the laboratory to the production level, the methodology of validation of the technological process, the process equipment used in the pharmaceutical industry.</td></tr>
<tr><td>11.</td><td colspan="7">Content of the study program:
– Concept of development of pharmaceutical formulations and transfer of technologies from the laboratory to the production industrial facilities;
– Formulation and reformulation of PDFs;
– Formulation and development of conventional PDFs;
– Formulation and development of modern PDFs;
– Incompatibilities in the formulation, stability, stabilization;
– Transferring the procedure to produce PDFs from the laboratory to the industrial level;
– Pharmaceutical-technological operations in the pharmaceutical industry: crushing, sieving;
– Pharmaceutical-technological operations in the pharmaceutical industry: mixing, homogenization and devices for mixing and homogenization;
– Filtrations and filtration devices in the pharmaceutical industry;
– Compression and compression devices in the pharmaceutical industry;
– Filling, packaging, storage and distribution of medicines.</td></tr>
<tr><td>12.</td><td colspan="7">Study methods:
Lectures, seminars, individual assignments, collaborative lectures, methods of group discussion.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">2 ECTS x 30 hours = 60 hours (2+0)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">30+0+10+10+10</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">0 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">10 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">10 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">10 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td>18.</td><td colspan="3">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
</table>

<table>
<tr><td></td><td></td><td colspan="3">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td></td><td></td><td colspan="3">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td></td><td></td><td colspan="3">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td></td><td></td><td colspan="3">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td></td><td></td><td colspan="3">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="4">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="4">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="8">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Khar, R. K., Vyas, S. P.</td><td>Lachman/Lieberman's The Theory and Practice of Industrial Pharmacy (4th Edition)</td><td>CBS Publishers & Distributors Pvt Ltd</td><td>2015</td></tr>
<tr><td>2.</td><td>Levin, M. (Editor)</td><td>Pharmaceutical Process Scale-Up (3rd Edition)</td><td>CRC Press</td><td>2011</td></tr>
<tr><td rowspan="4">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Sinko, P. J. (Editor)</td><td>Martin's Physical Pharmacy and Pharmaceutical Sciences (6th Edition)</td><td>Lippincott Williams & Wilkins</td><td>2008</td></tr>
<tr><td>2.</td><td>Allen, L., McPherson, T. B.</td><td>Ansel’s Pharmaceutical Dosage Forms and Drug Delivery Systems (12th Edition)</td><td>Lippincott Williams & Wilkins</td><td>2021</td></tr>
</table>

<table>
<tr><td colspan="3">Appendix 3
No. 51</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Name of the course</td><td colspan="5">COSMETOLOGY</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="5">3FMN196925</td></tr>
<tr><td>3.</td><td colspan="2">Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td colspan="2">Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td colspan="2">Fourth year /
Eighth semester</td><td>7.</td><td>Number of ECTS</td><td>2</td></tr>
<tr><td>8.</td><td colspan="2">Professor</td><td colspan="5">Assoc. Prof. Dr.sc. Elena Drakalska Sersemova</td></tr>
<tr><td>9.</td><td colspan="2">Pre-conditions for course registration</td><td colspan="5">Enrolled in eighth semester of studies</td></tr>
<tr><td>10.</td><td colspan="7">Aims of the study program (competences):
The objective of the course Cosmetology within the Pharmacy program is to familiarize students with composition, effects, preparation, and production of cosmetic products. The course includes fundamentals of skin anatomy and physiology, the medical aspects of the effects and potential side effects of cosmetic agents, characterization of cosmetic products, and both active substances and excipients used in cosmetic production concerning their properties, ingredients, manufacturing technology, and applications. Additionally, the course addresses the stability of cosmetic products and the quality standards they are required to meet.</td></tr>
<tr><td>11.</td><td colspan="7">Content of the study program:
– Regulation of cosmetology;
– Anatomy and physiology of the skin;
– Raw materials for cosmetics;
– Formulation and evaluation of cosmetic preparations;
– Physical and chemical quality control of cosmetic products;
– Characterization of dermato-cosmetic preparations;
– Application of nanotechnology in cosmetic formulation;
– Specialized cosmetic products;
– Adverse effects of cosmetic preparations;
– Cosmetovigilance;
– Organic cosmetics;
– Marketing of cosmetic preparations.</td></tr>
<tr><td>12.</td><td colspan="7">Study methods:
Lectures, interactive teaching and research work.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">2 ECTS x 30 hours = 60 hours (2+0)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">30+0+15+15+0</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">0 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">15 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">15 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">0 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="3">18.</td><td colspan="2" rowspan="3">Assessment criteria (points / grade)</td><td colspan="3">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="3">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="3">61 – 70 points</td><td>7 (seven) (D)</td></tr>
</table>

<table>
<tr><td></td><td colspan="2"></td><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="4">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="4">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>SCCS (Scientific Committee on Consumer Safety)</td><td>Guidance on the safety assessment of nanomaterials in cosmetics</td><td>European Commission</td><td>2023</td></tr>
<tr><td>2.</td><td>Cajkovac, M.</td><td>Cosmetology</td><td>Zagreb</td><td>2004</td></tr>
<tr><td>3.</td><td>Vasiljevic, D., Savic, S., Djordjevic, Lj., Krajisnik, D.</td><td>Handbook of Cosmetology</td><td>Nauka, Belgrade</td><td>2009</td></tr>
<tr><td rowspan="4">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Rieger, M. M.</td><td>Harry’s Cosmetology (8th Edition)</td><td>Chemical Publishing</td><td>2000</td></tr>
<tr><td>2.</td><td>Mohiuddin, A. K.</td><td>Cosmetics in use – A Pharmacological Review</td><td>Journal of Dermatology & Cosmetology</td><td>2019</td></tr>
</table>

<table>
<tr><td colspan="3">Appendix 3
No. 52</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Name of the course</td><td colspan="5">NUTRACEUTICALS</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="5">3FMN197025</td></tr>
<tr><td>3.</td><td colspan="2">Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td colspan="2">Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td colspan="2">Fourth year /
Eighth semester</td><td>7.</td><td>Number of ECTS</td><td>2</td></tr>
<tr><td>8.</td><td colspan="2">Professor</td><td colspan="5">Assoc. Prof. Dr.sc. Katarina Smilkov</td></tr>
<tr><td>9.</td><td colspan="2">Pre-conditions for course registration</td><td colspan="5">Enrolled in eighth semester of studies</td></tr>
<tr><td>10.</td><td colspan="7">Aims of the study program (competences):
– Acquiring a comprehensive understanding of nutraceuticals, focusing on bioactive components derived from food and their roles in human health;
– Gaining knowledge of the most commonly utilized bioactive compounds from food and their significance in maintaining and promoting human health;
– Developing an understanding of the toxicological potential of bioactive compounds from food and their safety profiles.</td></tr>
<tr><td>11.</td><td colspan="7">Content of the study program:
– Classification of Nutraceuticals: comprehensive classification of nutraceuticals based on their origin, chemical composition, and mechanisms of action;
– Bioactive components in food: an overview of bioactive food components, including carbohydrates, lipids, bioactive peptides, amino-acids, polyphenols, carotenoids, and other compounds with confirmed health-promoting effects;
– Applications of nutraceuticals in health promotion: overview of nutraceuticals used to enhance the functions of various organs and organ systems, including the skeletal-muscular, cardiovascular, nervous, respiratory, and reproductive systems. Exploring nutraceuticals with a role in cancer prevention, weight management, skin and oral health, and improvement of sports performance with an emphasis on their overall bioactive properties and therapeutic potential;
– Toxicological considerations of bioactive food components: evaluation of the toxicological potential of bioactive components in food, assessing their safety, possible adverse effects, and dose-related toxicological risks.</td></tr>
<tr><td>12.</td><td colspan="7">Study methods:
Lectures, theoretical and practical exercises, consultations, self-based learning, seminars, additional preparation for exams and tests.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">2 ECTS x 30 hours = 60 hours (2+0)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">30+0+10+0+20</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">0 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">10 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">0 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">20 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="2">18.</td><td colspan="3" rowspan="2">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td colspan="2">5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td colspan="2">6 (six) (E)</td></tr>
</table>

			61 – 70 points		7 (seven) (D)
			71 – 80 points		8 (eight) (C)
			81 – 90 points		9 (nine) (B)
			91 – 100 points		10 (ten) (A)
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.		
20.	Language of the study program		English		
21.	Quality assurance methods of the teaching process		Self-evaluation		
22.	Literature				
	22.1.	Mandatory literature			
		No.	Author	Title	Publisher	Year
		1.	Smilkov, K.	*Authorized lectures*	Goce Delcev University, Stip	2024
		2.	Cicero, A. F. G., Colletti, A.	*Handbook of Nutraceuticals for Clinical Use*	Springer	2018
		3.	Aluko, R. E.	*Functional foods and nutraceuticals*	Springer	2012
		4.	Lockwood, B.	*Nutraceuticals*	Pharmaceutical Press	2007
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Belitz, H. D., Grosch, W., Schieberle, P.	*Food Chemistry (4th Edition, revised and extended)*	Springer	2009
		2.	Hurst, W. J. (Editor)	*Methods of Analysis for Functional Foods and Nutraceuticals (2nd Edition)*	CRC Press	2008
		3.	Mahan, K. L., Raymond, J. L. (Editors)	*Krause's Food & the nutrition care process (14th Edition)*	Elsevier	2017

Appendix 3 No. 53			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**PHARMACOECONOMICS AND PHARMACEUTICAL MARKETING**			
2.	Code		3FMN197125			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Fourth year / Eighth semester	7.	Number of ECTS	2
8.	Professor		Adj. Ass. Prof. Dr.sc. Zoran Nakov			
9.	Pre-conditions for course registration		Enrolled in eighth semester of studies			
10.	**Aims of the study program (competences):** – Gaining knowledge about the basic principles of pharmacoeconomic analysis; – Gaining knowledge about pharmacoeconomics and healthcare systems; – Gaining capability for health technology assessment.					
11.	**Content of the study program:** – Methods of pharmacoeconomic analysis; – Principles of pharmacoeconomic analysis; – Pharmacoeconomics and health politics; – Basic principles of drug pricing models and reimbursement process; – Health Technology Assessments; – Sales skills in pharmaceutical industry.					
12.	**Study methods:** Lectures, seminars and case studies.					
13.	Total amount of time available		2 ECTS x 30 hours = 60 hours (2+0)			
14.	Distribution of tasks		30+0+0+15+15			
15.	Types of learning/teaching activities	15.1.	Lectures – theory		30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork		0 hours	
16.	Other types of activities	16.1.	Projects		0 hours	
		16.2.	Individual tasks		15 hours	
		16.3.	Home study – tasks		15 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			40 points	
	17.2.	Individual tasks / project (presentation: written and oral)			10 points	
	17.3.	Activity and participation			20 points	
	17.4.	Final exam			30 points	
18.	Assessment criteria (points / grade)		Up to 50 points		5 (five) (F)	
			51 – 60 points		6 (six) (E)	
			61 – 70 points		7 (seven) (D)	
			71 – 80 points		8 (eight) (C)	
			81 – 90 points		9 (nine) (B)	
			91 – 100 points		10 (ten) (A)	
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.			
20.	Language of the study program		English			
21.	Quality assurance methods of the teaching process		Self-evaluation			
22.	Literature					

	22.1.	Mandatory literature				
		No.	Author	Title	Publisher	Year
		1.	Arnold, R. J. G.	*Pharmacoeconomics: From Theory to Practice (2nd Edition)*	CRC Press	2021
		2.	Zgarrick, D. P., Desselle, S. P., Moczygemba, L. R., Alston, G.	*Pharmacy Management: Essentials for All Practice Settings (5th Edition)*	McGraw Hill	2020
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Garrido, M. V., Kristensen, F. B., Nielsen, C. P., Busse, R. (Editors)	*Health technology assessment and health policy-making in Europe: current status, challenges and potential*	World Health Organization on behalf of the European Observatory on Health Systems and Policies	2008

<table>
<tr><td colspan="3">Appendix 3
No. 54</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Name of the course</td><td colspan="5">ENZYMES AND ENZYME INHIBITORS</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="5">3FMN197225</td></tr>
<tr><td>3.</td><td colspan="2">Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td colspan="2">Study program organizer
(department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td colspan="2">Fourth year /
Eighth semester</td><td>7.</td><td>Number of ECTS</td><td>2</td></tr>
<tr><td>8.</td><td colspan="2">Professor</td><td colspan="5">Ass. Prof. Dr.sc. Marija Arev</td></tr>
<tr><td>9.</td><td colspan="2">Pre-conditions for course registration</td><td colspan="5">Enrolled in eighth semester of studies</td></tr>
<tr><td>10.</td><td colspan="7">Aims of the study program (competences):
This curriculum provides a clear introduction to the structure and properties of enzymes, explaining their key role in biological processes. It will discuss how enzymes serve as important targets for many drugs, influencing their activity in order to treat various diseases. By understanding how enzymes function, students can better appreciate their significance in both normal cellular operations and in therapeutic interventions.
The curriculum will also examine how certain drugs act as enzyme inhibitors, blocking enzyme activity through different mechanisms such as competitive, non-competitive, and allosteric inhibition. These mechanisms are crucial in drug design, as inhibiting specific enzymes can help manage or cure diseases. Several examples of enzyme-inhibiting drugs will be highlighted, showcasing how this approach is applied in clinical settings to provide effective treatments for conditions such as hypertension, infections, and cancer.</td></tr>
<tr><td>11.</td><td colspan="7">Content of the study program:
1. Proteins: structure and biological importance, classification and properties of some important proteins;
2. Enzymes: definition, nomenclature, general properties, and structure of enzymes;
3. Mechanisms of catalytical activity of enzymes and classification;
4. Enzyme specificity;
5. Cofactors and coenzymes;
6. Enzyme kinetics;
7. Factors affecting enzyme activity, denaturation;
8. Enzyme activators and inhibitors;
9. Diagnostic enzymes;
10. Pharmacological significance of enzymes; enzymes as drug target;
11. Various types of drug enzyme inhibition;
12. Pharmacological examples and mechanisms of action of enzyme inhibitors.</td></tr>
<tr><td>12.</td><td colspan="7">Study methods:
Lectures, exercises, theoretical and practical exercises, seminars, consultation and individual learning.</td></tr>
<tr><td>13.</td><td colspan="3">Total amount of time available</td><td colspan="3">2 ECTS x 30 hours = 60 hours (2+0)</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of tasks</td><td colspan="3">30+0+0+15+15</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">0 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td colspan="2">0 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td colspan="2">15 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td colspan="2">15 hours</td></tr>
<tr><td rowspan="3">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
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<tr><td></td><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td></td><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td>Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td>51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td>61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td>71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td>81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td>91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="2">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="2">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="2">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="4">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Zollner, H.</td><td>Handbook of Enzyme Inhibitors (3rd Edition)</td><td>Wiley</td><td>2008</td></tr>
<tr><td>2.</td><td>Copeland, R. A.</td><td>Evolution of Enzyme Inhibitors in Drug Discovery: A Guide for Medical Chemists and Pharmacologists (1st Edition)</td><td>Wiley</td><td>2013</td></tr>
<tr><td>3.</td><td>Smith, H. J., Simons, C.</td><td>Enzymes and Their Inhibitors: Drug Development (1st Edition)</td><td>CRC Press</td><td>2004</td></tr>
<tr><td rowspan="4">22.2.</td><td colspan="4">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Matthews, J. C.</td><td>Fundamentals of Receptor, Enzyme and Transport Kinetics</td><td>CRC Press</td><td>1993</td></tr>
<tr><td>2.</td><td>Aebisher, D., Bartusik-Aebisher, D.</td><td>The Biochemical Guide to Enzymes</td><td>Wiley</td><td>2022</td></tr>
<tr><td>3.</td><td>Lashinski, E. M.</td><td>Enzymes and Enzyme Activity: Structure, Biology and Clinical Significance</td><td>Nova Science Pub</td><td>2013</td></tr>
</table>

Appendix 3 No. 55			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**CONTEMPORARY ASPECTS OF HERBAL DRUGS**			
2.	Code		3FMN197325			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Fourth year / Eighth semester	7.	Number of ECTS	2
8.	Professor		Assoc. Prof. Dr.sc. Viktorija Maksimova Ass. Prof. Dr.sc. Milkica Arsova			
9.	Pre-conditions for course registration		Enrolled in eighth semester of studies			
10.	**Aims of the study program (competences):** Through this course, students should become familiar with contemporary aspects of the use of herbal medicines. In doing so, by defining the concepts of herbal substance, herbal processing, and herbal medicine, they will additionally learn about: the methodology for the development of new herbal medicines from raw material to finished product; methods for obtaining extracts and incorporating them into herbal medicine or traditional herbal medicine; procedures for registering herbal medicine/traditional herbal medicine and their regulation in the country vs. abroad; critical points in quality control of herbal preparations; legal regulations for the cultivation of medical cannabis and its medical use.					
11.	**Content of the study program:** – The importance of herbal medicines as OTC (over the counter) preparations in modern phytotherapy; – The concept and types of herbal medicines; – Formulation, production, and commercialization of herbal medicines; – Pre-production and production processes in obtaining herbal medicine; – GMP principles in the production of herbal medicines; – Regulation and registration of herbal medicines; – Critical points in quality control of herbal medicines and validation of analytical procedures involved in this process; – Medical use of cannabis, legal regulations related to the cultivation of medical cannabis, and the use of cannabis preparations with or without THC.					
12.	**Study methods:** Lectures, consultations, group and individual work (project tasks with oral presentation).					
13.	Total amount of time available		2 ECTS x 30 hours = 60 hours (2+0)			
14.	Distribution of tasks		30+0+10+10+10			
15.	Types of learning/teaching activities	15.1.	Lectures – theory		30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork		0 hours	
16.	Other types of activities	16.1.	Projects		10 hours	
		16.2.	Individual tasks		10 hours	
		16.3.	Home study – tasks		10 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			40 points	
	17.2.	Individual tasks / project (presentation: written and oral)			10 points	
	17.3.	Activity and participation			20 points	
	17.4.	Final exam			30 points	
18.	Assessment criteria (points / grade)		Up to 50 points		5 (five) (F)	
			51 – 60 points		6 (six) (E)	

<table>
<tr><td></td><td colspan="3"></td><td>61 – 70 points</td><td colspan="2">7 (seven) (D)</td></tr>
<tr><td></td><td colspan="3"></td><td>71 – 80 points</td><td colspan="2">8 (eight) (C)</td></tr>
<tr><td></td><td colspan="3"></td><td>81 – 90 points</td><td colspan="2">9 (nine) (B)</td></tr>
<tr><td></td><td colspan="3"></td><td>91 – 100 points</td><td colspan="2">10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="10">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Khan, M. S. A., Ahmad, H., Chattopadhyay, D.</td><td>New Look to Phytomedicine: Advancements in Herbal Products as Novel Drug Leads</td><td>Elsevier</td><td>2018</td></tr>
<tr><td>2.</td><td>Haensel, R., Sticher, O.</td><td>Pharmakognosie – Phytopharmazie</td><td>Springer</td><td>2007</td></tr>
<tr><td>3.</td><td>Maksimova, V.</td><td>Contemporary Aspects of the Use of Herbal Medicines</td><td>Goce Delcev University, Stip</td><td>2023</td></tr>
<tr><td rowspan="4">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>World Health Organization</td><td>Quality Control Methods for Medicinal Plant Materials</td><td>World Health Organization</td><td>1999</td></tr>
<tr><td>2.</td><td>European Pharmacopoeia Commission</td><td>European Pharmacopoeia (Ph. Eur.)</td><td>Council of Europe</td><td>Current issue</td></tr>
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<tr><td colspan="2">Appendix 3
No. 56</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="5">RADIOPHARMACY</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="5">3FMN197425</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer
(department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td>Fifth year /
Ninth semester</td><td>7.</td><td>Number of
ECTS</td><td colspan="2">2</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="5">Full Prof. Dr.sc. Emilija Janevik-Ivanovska</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="5">Enrolled in ninth semester of studies</td></tr>
<tr><td>10.</td><td colspan="6">Aims of the study program (competences):
The goal of the Radiopharmacy course is to introduce the students with:
– The fundamental knowledge in Radiopharmacy, including understanding of the types, preparation, and applications od radiopharmaceuticals used in nuclear medicine;
– The basic concepts of radiation physics, including knowledge of radiation types (alpha, beta, gamma), radiation detection, safety protocols, and the principles of radioactive decay, half-life, and the interactions of radiation with matter;
– Radiation protection and safety;
– Pharmacokinetics and Biodistribution studies of radiopharmaceuticals;
– Learning methods of production of radioactive isotopes and radiopharmaceutical preparations:
– Chemistry of Radionuclides – understanding the chemical behavior of radionuclides, how they bind to biomolecules, and the radiolabeling techniques used;
– Radiopharmaceutical Synthesis using various radionuclides (e.g., Tc-99m, F-18, I-131), handling, radionuclide generators, cyclotrons, and other radiopharmaceutical techniques;
– Quality Control – proficiency in performing quality control tests for radiopharmaceuticals (e.g., radiochemical purity, sterility, endotoxin levels);
– Clinical applications of Radiopharmaceuticals – Imagining Techniques (knowledge of different imaging modalities that use radiopharmaceuticals, such as PET, SPECT and their representative radiopharmaceuticals) and Therapeutic Applications (understanding the use of radiopharmaceuticals for targeted therapy – radionuclide therapy, radioactive iodine for thyroid cancer treatment);
– Regulatory Knowledge, Good Manufacturing Practices (GMP) and Good Radiopharmaceutical Practices (GRPP);
– Research and Development in Radiopharmacy – Innovative Radiopharmaceuticals and Preclinical and Clinical Studies.
Students are expected to be equipped with the necessary theoretical knowledge and practical skills to work safely and effectively in the field of Radiopharmacy, contributing to advancements in nuclear medicine and radiopharmaceutical development.</td></tr>
<tr><td>11.</td><td colspan="6">Content of the study program:
– Introduction to Radiopharmacy – basics of ionization radiation, nuclear decay, characteristics of nuclear radiation;
– Interactions of matter with ionizing radiation, ionizing radiation detection systems, detection instruments;
– Biological effects of ionizing radiation – dosimetry and radiation protection;
– Obtaining radionuclides used in medicine and pharmacy;</td></tr>
</table>

<table>
<tr><td></td><td colspan="5">– Mechanism of action of radiopharmaceuticals containing radionuclides for human use;
– Radiopharmaceutical preparations of iodine isotopes;
– Technetium-99m radiopharmaceuticals;
– Radiopharmaceutical preparations of other gamma emitters for diagnostics;
– Basics of positron emission tomography (PET), production and synthesis of PET radiopharmaceuticals;
– PET radiopharmaceuticals – with fluorine-18, carbon-11, nitrogen-13, oxygen-16, gallium-68, copper-64, zirnocnium-89;
– Radiopharmaceutical preparations of beta and alpha emitters for therapy (Theranostics);
– Quality control of radiopharmaceuticals;
– Legislation, Radiopharmaceutical Laboratory Design, Hospital Radiopharmacy, Centralized Laboratory;
– Implementation of Good Manufacturing Practices in Radiopharmacy.</td></tr>
<tr><td>12.</td><td colspan="5">Study methods:
Lectures, laboratory exercises, consultations, seminars.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="3">2 ECTS x 30 hours = 60 hours (2+0)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="3">30+0+0+0+30</td></tr>
<tr><td rowspan="2">15.</td><td colspan="2" rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td>Lectures – theory</td><td>30 hours</td></tr>
<tr><td>15.2.</td><td>Tutorials (laboratory, auditory), seminars, teamwork</td><td>0 hours</td></tr>
<tr><td rowspan="3">16.</td><td colspan="2" rowspan="3">Other types of activities</td><td>16.1.</td><td>Projects</td><td>0 hours</td></tr>
<tr><td>16.2.</td><td>Individual tasks</td><td>0 hours</td></tr>
<tr><td>16.3.</td><td>Home study – tasks</td><td>30 hours</td></tr>
<tr><td rowspan="5">17.</td><td colspan="5">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="3">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="3">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="3">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="3">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="4">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="4">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Kilbourn, M. R., Scott, P. J. H.</td><td>Handbook of Radiopharmaceuticals – Methodology and Application (2nd Edition)</td><td>Wiley</td><td>2021</td></tr>
<tr><td></td><td>2.</td><td>Saha, G. B.</td><td>Fundamentals of Nuclear Pharmacy</td><td>Springer</td><td>2010</td></tr>
</table>

		3.	Theobald, T. (Editor)	*Sampson's Textbook of Radiopharmacy (4th Edition)*	Pharmaceutical Press	2010
	22.2.	Additional literature				
		No.	Author	Title	Publisher	Year
		1.	Group of authors	*Operational Guidance on Hospital Radiopharmacy: A Safe and Effective Approach*	International Atomic Energy Agency	2008
		2.	Peller, P. J. (Editor)	*PET Radiochemistry and Radiopharmacy, PET-CT and PET-MRI in Oncology, Medical Radiology. Diagnostic Imaging*	Springer	2012
		3.	Schillaci, O., Calabria, F. (Editors)	*Radiopharmaceuticals: a guide to PET/CT and PET/MRI*	Springer	2020

Appendix 3 No. 57			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**VALIDATION AND QUALIFICATION IN ANALYTICAL LABORATORIES**			
2.	Code		3FMN197525			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Fifth year / Ninth semester	7.	Number of ECTS	2
8.	Professor		Full Prof. Dr.sc. Zorica Arsova Sarafinovska			
9.	Pre-conditions for course registration		Enrolled in ninth semester of studies			
10.	**Aims of the study program (competences):** The aim of the study program is to introduce students with the principles of qualification of analytical laboratory; ensuring the quality system in laboratory activities in accordance with national and international standards and regulations.					
11.	**Content of the study program:** – Organization of analytical laboratories; – Facilities and environmental conditions; – Qualification of equipment, management of reagents and consumables; – Equipment calibration and metrological traceability; – Standard operative procedure; – Method verification and validation; – Quality management system; – Quality assessment of test results – participation in proficiency tests, inter-laboratory comparisons and internal quality controls; – Accreditation procedures; – Standards and guidelines – national and international regulation.					
12.	**Study methods:** Lectures (theory) in a large group of students with discussion and student engagement, e-learning, individual consultations with students and consultations in groups.					
13.	Total amount of time available		2 ECTS x 30 hours = 60 hours (2+0)			
14.	Distribution of tasks		30+0+0+10+20			
15.	Types of learning/teaching activities	15.1.	Lectures – theory		30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork		0 hours	
16.	Other types of activities	16.1.	Projects		0 hours	
		16.2.	Individual tasks		10 hours	
		16.3.	Home study – tasks		20 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			40 points	
	17.2.	Individual tasks / project (presentation: written and oral)			10 points	
	17.3.	Activity and participation			20 points	
	17.4.	Final exam			30 points	
18.	Assessment criteria (points / grade)		Up to 50 points		5 (five) (F)	
			51 – 60 points		6 (six) (E)	
			61 – 70 points		7 (seven) (D)	
			71 – 80 points		8 (eight) (C)	
			81 – 90 points		9 (nine) (B)	
			91 – 100 points		10 (ten) (A)	

<table>
<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="4">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="4">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="8">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="3">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Funk, W., Dammann, V., Donnevert, G.</td><td>Quality Assurance in Pharmaceutical Chemistry</td><td>Wiley</td><td>2007</td></tr>
<tr><td></td><td>2.</td><td colspan="4">International standards and guidelines (ICH Guidelines; OMCL Guidelines; MKC EN ISO/IEC 17025:2018)</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td></td><td></td><td></td><td></td></tr>
</table>

Appendix 3 No. 58		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**ANALYSES IN CLINICAL TOXICOLOGY**			
2.	Code	3FMN197625			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Fifth year / Ninth semester	7.	Number of ECTS	2
8.	Professor	Assoc. Prof. Dr.sc. Darinka Gjorgieva Ackova			
9.	Pre-conditions for course registration	Enrolled in ninth semester of studies			
10.	**Aims of the study program (competences):** The course guides students into the field of clinical toxicology as a specialized subfield of toxicology. They acquire knowledge about toxins and toxicants, mechanisms of toxicity, methods for detection of toxic agents that are most often found as causes of poisoning, processing of different types of samples, as well as the approach for treatment and application of antidotes in case of poisoning.				
11.	**Content of the study program:** 1. Introduction to analytical toxicological analyses; 2. Occurrence, diagnosis, prevention and treatment of poisoning; 3. Clinical toxicology. Therapeutic monitoring; 4. Pediatric toxicology; 5. Analyzes of alcohol and substances of abuse in traffic violations; 6. Analyzes of drugs and substances of abuse in sports and doping; 7. Forensic and post mortem analyzes; 8. Medicinal products, volatile substances, natural toxins, pesticides and identification of solid forms; 9. Sampling, storage, processing (extraction) and stability; 10. Application of chromatographic (TLC, GC, HPLC) and spectro/photo/methods (UV/VIS and fluorescence spectrophotometry, FTIR/Raman spectroscopy, mass spectrometry) for sample analysis in poisoning diagnostics; 11. Application of immunochemical methods for sample analysis in poisoning diagnostics; 12. Development of a method for analysis and validation. Quality control and accreditation in a toxicological laboratory. Interpretation of toxicological results.				
12.	**Study methods:** Lectures, project assignments, case-studies, consultations, in small groups of up to 10 students.				
13.	Total amount of time available	2 ECTS x 30 hours = 60 hours (2+0)			
14.	Distribution of tasks	30+0+10+0+20			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	0 hours	
16.	Other types of activities	16.1.	Projects	10 hours	
		16.2.	Individual tasks	0 hours	
		16.3.	Home study – tasks	20 hours	
17.	Evaluation / assessment methods				
	17.1.	Tests		40 points	
	17.2.	Individual tasks / project (presentation: written and oral)		10 points	
	17.3.	Activity and participation		20 points	
	17.4.	Final exam		30 points	

<table>
<tr><td rowspan="6">18.</td><td colspan="3" rowspan="6">Assessment criteria (points / grade)</td><td colspan="2">Up to 50 points</td><td>5 (five) (F)</td></tr>
<tr><td colspan="2">51 – 60 points</td><td>6 (six) (E)</td></tr>
<tr><td colspan="2">61 – 70 points</td><td>7 (seven) (D)</td></tr>
<tr><td colspan="2">71 – 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td colspan="2">81 – 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td colspan="2">91 – 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Eligibility for signature and taking the final exam</td><td colspan="3">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="3">Language of the study program</td><td colspan="3">English</td></tr>
<tr><td>21.</td><td colspan="3">Quality assurance methods of the teaching process</td><td colspan="3">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Moffat, A. C., Osselton, M. D., Widdop, B. (Editors)</td><td>Clarke’s analysis of drugs and poisons (4th Edition)</td><td>Pharmaceutical Press</td><td>2011</td></tr>
<tr><td>2.</td><td>Jickells, S., Negrusz, A. (Editors)</td><td>Clarke’s analytical Forensic toxicology</td><td>Pharmaceutical Press</td><td>2008</td></tr>
<tr><td>3.</td><td>Pena-Fernandez, A., Evans, M. D., Cooke, M. S.</td><td>Toxicology for the Health and Pharmaceutical Sciences</td><td>CRC Press</td><td>2022</td></tr>
<tr><td rowspan="4">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Gjorgieva Ackova, D.</td><td>Authorized lectures</td><td>Goce Delcev University, Stip</td><td>2024</td></tr>
<tr><td>2.</td><td>True, B-L., Driesbach, R. (Editors)</td><td>Dreisbach’s handbook of poisoning: Prevention, diagnosis and treatment (13th Edition)</td><td>CRC Press</td><td>2001</td></tr>
</table>

Appendix 3 No. 59			**Study program for integrated first and second cycle of studies**			
1.	Name of the course		**PHARMACEUTICAL LEGISLATION AND REGISTRATION OF MEDICINES AND MEDICAL DEVICES**			
2.	Code		3FMN197725			
3.	Study program		Pharmacy			
4.	Study program organizer (department, institute, branch)		Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)		Integrated first and second cycle of studies			
6.	Academic year / semester		Fifth year / Ninth semester	7.	Number of ECTS	2
8.	Professor		Assoc. Prof. Dr.sc. Marija Darkovska Serafimovska			
9.	Pre-conditions for course registration		Enrolled in ninth semester of studies			
10.	**Aims of the study program (competences):** The aim of the course is for students to gain knowledge about the pharmaceutical legislation and marketing authorization and regulation of medicines and medical devices.					
11.	**Content of the study program:** Registration procedures/types of applications for placing the medicine on the market in accordance with European regulations; Organization of CTD documentation for registration (marketing authorization) of the medicine; Changes in the approved marketing authorization for medicines (variations and their classification); Harmonization of national and European regulations; Regulatory measures for protection against falsification of medicines; Concept and definition of medical devices for use in human medicine, conditions and procedure for their production, a way to ensure their quality, safety and efficiency; Classification of medical devices; Confirmatory assessment of medical devices; Labeling, sales and advertising of medical devices; Clinical trials of medicinal product.					
12.	**Study methods:** Lectures, group discussion methods, individual work.					
13.	Total amount of time available		2 ECTS x 30 hours = 60 hours (2+0)			
14.	Distribution of tasks		30+0+0+20+10			
15.	Types of learning/teaching activities	15.1.	Lectures – theory		30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork		0 hours	
16.	Other types of activities	16.1.	Projects		0 hours	
		16.2.	Individual tasks		20 hours	
		16.3.	Home study – tasks		10 hours	
17.	Evaluation / assessment methods					
	17.1.	Tests			40 points	
	17.2.	Individual tasks / project (presentation: written and oral)			10 points	
	17.3.	Activity and participation			20 points	
	17.4.	Final exam			30 points	
18.	Assessment criteria (points / grade)		Up to 50 points		5 (five) (F)	
			51 – 60 points		6 (six) (E)	
			61 – 70 points		7 (seven) (D)	
			71 – 80 points		8 (eight) (C)	
			81 – 90 points		9 (nine) (B)	
			91 – 100 points		10 (ten) (A)	
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.			
20.	Language of the study program		English			

<table>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="6">Literature</td></tr>
<tr><td rowspan="7">22.1.</td><td colspan="5">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td colspan="2">Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td colspan="3">Law on Medicines and Medical Devices in North Macedonia</td><td>Current issue</td></tr>
<tr><td>2.</td><td colspan="3">EU directives</td><td>Current issue</td></tr>
<tr><td>3.</td><td colspan="3">ICH Guidelines</td><td>Current issue</td></tr>
<tr><td>4.</td><td colspan="3">EMA QWP Guides</td><td>Current issue</td></tr>
<tr><td>5.</td><td colspan="3">FDA Guidelines</td><td>Current issue</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td colspan="2">Appendix 3
No. 60</td><td colspan="5">Study program for integrated first and second cycle of studies</td></tr>
<tr><td>1.</td><td>Name of the course</td><td colspan="5">PHARMACEUTICAL CARE AND PHARMACOVIGILANCE</td></tr>
<tr><td>2.</td><td>Code</td><td colspan="5">3FMN197825</td></tr>
<tr><td>3.</td><td>Study program</td><td colspan="5">Pharmacy</td></tr>
<tr><td>4.</td><td>Study program organizer (department, institute, branch)</td><td colspan="5">Faculty of Medical Sciences,
Goce Delcev University, Stip</td></tr>
<tr><td>5.</td><td>Degree (first, second, third cycle)</td><td colspan="5">Integrated first and second cycle of studies</td></tr>
<tr><td>6.</td><td>Academic year / semester</td><td colspan="2">Fifth year /
Ninth semester</td><td>7.</td><td>Number of ECTS</td><td>2</td></tr>
<tr><td>8.</td><td>Professor</td><td colspan="5">Assoc. Prof. Dr.sc. Biljana Lazarova</td></tr>
<tr><td>9.</td><td>Pre-conditions for course registration</td><td colspan="5">Enrolled in ninth semester of studies</td></tr>
<tr><td>10.</td><td colspan="6">Aims of the study program (competences):
– Gaining knowledge to describe the definition of pharmacist-provided pharmaceutical care services, recommendations for required service components, alignment of documentation and roles and responsibilities of pharmacists providing the service;
– Pharmaceutical care services will support the continuity of care by health professionals from different disciplines to care for a patient both when the patient is in hospital and when the patient is discharged to home or ambulatory care;
– Patient-specific information and medications could be shared among healthcare professionals to help ensure patient safety across the continuum of care and empower patients to take responsibility for their own health;
– Students to acquire knowledge of pharmacovigilance as a “science and activities related to detecting, assessing, understanding and preventing adverse effects or any other potential drug-related problem”.</td></tr>
<tr><td>11.</td><td colspan="6">Content of the study program:
– Pharmaceutical care focuses on patient-centered services aimed at empowering patients and/or caregivers to take responsibility for their medication needs and achieve the best health outcome;
– Pharmaceutical care services should complement existing patient care practices to make drug therapy more effective and safer;
– Who should receive pharmaceutical care and how often;
– How pharmaceutical care should be performed;
– Components for pharmaceutical care services;
– Improving patient care and safety related to the use of medicines and all medical and paramedical interventions;
– Contribution of the assessment of benefit, harm, effectiveness and risk of drug use, leading to prevention of harm and maximization of benefit;
– Encouraging safe, rational and more efficient (including economical) use of medicines.</td></tr>
<tr><td>12.</td><td colspan="6">Study methods:
Lectures with large groups of students, individual assignments, group discussions, homework, home study and student seminars.</td></tr>
<tr><td>13.</td><td colspan="2">Total amount of time available</td><td colspan="4">2 ECTS x 30 hours = 60 hours (2+0)</td></tr>
<tr><td>14.</td><td colspan="2">Distribution of tasks</td><td colspan="4">30+0+10+10+10</td></tr>
<tr><td rowspan="2">15.</td><td rowspan="2">Types of learning/teaching activities</td><td>15.1.</td><td colspan="2">Lectures – theory</td><td colspan="2">30 hours</td></tr>
<tr><td>15.2.</td><td colspan="2">Tutorials (laboratory, auditory), seminars, teamwork</td><td colspan="2">0 hours</td></tr>
<tr><td rowspan="3">16.</td><td rowspan="3">Other types of activities</td><td>16.1.</td><td colspan="2">Projects</td><td colspan="2">10 hours</td></tr>
<tr><td>16.2.</td><td colspan="2">Individual tasks</td><td colspan="2">10 hours</td></tr>
<tr><td>16.3.</td><td colspan="2">Home study – tasks</td><td colspan="2">10 hours</td></tr>
</table>

<table>
<tr><td rowspan="5">17.</td><td colspan="6">Evaluation / assessment methods</td></tr>
<tr><td>17.1.</td><td colspan="4">Tests</td><td>40 points</td></tr>
<tr><td>17.2.</td><td colspan="4">Individual tasks / project (presentation: written and oral)</td><td>10 points</td></tr>
<tr><td>17.3.</td><td colspan="4">Activity and participation</td><td>20 points</td></tr>
<tr><td>17.4.</td><td colspan="4">Final exam</td><td>30 points</td></tr>
<tr><td rowspan="6">18.</td><td colspan="2" rowspan="6">Assessment criteria (points / grade)</td><td colspan="3">Up to 50 points</td><td>5 (five) (F)</td></tr>
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<tr><td colspan="3">81 – 90 points</td><td>9 (nine) (B)</td></tr>
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<tr><td>19.</td><td colspan="2">Eligibility for signature and taking the final exam</td><td colspan="4">60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.</td></tr>
<tr><td>20.</td><td colspan="2">Language of the study program</td><td colspan="4">English</td></tr>
<tr><td>21.</td><td colspan="2">Quality assurance methods of the teaching process</td><td colspan="4">Self-evaluation</td></tr>
<tr><td rowspan="11">22.</td><td colspan="7">Literature</td></tr>
<tr><td rowspan="5">22.1.</td><td colspan="6">Mandatory literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td colspan="2">Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Farris, K. B., Fernandez-Llimos, F., Benrimoj, S. I.</td><td>Pharmaceutical Care in Community Pharmacies: Practice and Research from Around the World</td><td colspan="2">Annals of Pharmacotherapy</td><td>2005</td></tr>
<tr><td>2.</td><td>Allemann, S. S., Foppe can Mil, J. W., Botermann, L., Berger, K., Griese, N., Hersberger, K. E.</td><td>Pharmaceutical care: the PCNE definition 2013</td><td colspan="2">International Journal of Clinical Pharmacy</td><td>2014</td></tr>
<tr><td>3.</td><td>Judd, A., Collins, I. J., Haile-Selassie, H., Rakhmanina, N., Sturkenboom, M.</td><td>Pharmacovigilance</td><td colspan="2">World Health Organization</td><td>2018</td></tr>
<tr><td>4.</td><td>International Federation of Pharmaceutical Manufacturers and Associations</td><td>IFPMA Position Paper on Pharmacovigilance Principles for Biotherapeutic Medicines</td><td colspan="2">International Federation of Pharmaceutical Manufacturers and Associations</td><td>2018</td></tr>
<tr><td rowspan="3">22.2.</td><td colspan="6">Additional literature</td></tr>
<tr><td>No.</td><td>Author</td><td>Title</td><td colspan="2">Publisher</td><td>Year</td></tr>
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</table>

Appendix 3 No. 61		**Study program for integrated first and second cycle of studies**			
1.	Name of the course	**STABILITY OF MEDICINAL PRODUCTS**			
2.	Code	3FMN197925			
3.	Study program	Pharmacy			
4.	Study program organizer (department, institute, branch)	Faculty of Medical Sciences, Goce Delcev University, Stip			
5.	Degree (first, second, third cycle)	Integrated first and second cycle of studies			
6.	Academic year / semester	Fifth year / Ninth semester	7.	Number of ECTS	2
8.	Professor	Ass. Prof. Dr.sc. Ivana Mitrevska			
9.	Pre-conditions for course registration	Enrolled in ninth semester of studies			
10.	**Aims of the study program (competences):** The study program objective for the students is to gain knowledge for a comprehensive resource on how the pharmaceutical industry can enhance their understanding of a product's stability and predict drug expiry more accurately and quickly. The students will be able to provides high level strategies for the successful implementation of APS in a pharmaceutical company. Pharmaceutical student will be able to handle responsibilities in a variety of functions relating to the drug stability, including R&D, formulation, analytical development, QA/QC, regulatory affairs and production. Gaining knowledge to scientific understanding of regulations and balances methodologies and best practices. The study program will enable to the students for better understand key concepts such as rate and order of reaction, reaction equilibrium, complex reaction mechanisms and an in-depth discussion of both aqueous and solid drug solutions and contains the latest international regulatory requirements on drug stability. This study program will give an overview of tools that a student should have in order to evaluate the impact of excursions from the storage label instructions on the disposition of distributed shipments of pharmaceutical/biopharmaceutical products.				
11.	**Content of the study program:** 1. Understanding ICH Guidelines Applicable to Stability Testing 2. Global Stability Practices 3. Post-approval Changes – Stability Requirements and Regulations 4. Understanding and Predicting Pharmaceutical Product Shelf-Life 5. Development of Stability Indicating Methods 6. Impact of Solid-State Characteristics to the Physical Stability of Drug Substance and Drug Product 7. Evaluation of Stability Data 8. Stability Operation Practices 9. Qualification, Calibration, and Maintenance of Stability Chambers 10. Accelerated Predictive Stability 11. Stability Studies for Biologics				
12.	**Study methods:** Lectures with large groups of students, individual assignments, group discussions, homework, home study and student seminars.				
13.	Total amount of time available	2 ECTS x 30 hours = 60 hours (2+0)			
14.	Distribution of tasks	30+0+10+10+10			
15.	Types of learning/teaching activities	15.1.	Lectures – theory	30 hours	
		15.2.	Tutorials (laboratory, auditory), seminars, teamwork	0 hours	
16.	Other types of activities	16.1.	Projects	10 hours	
		16.2.	Individual tasks	10 hours	
		16.3.	Home study – tasks	10 hours	
17.	Evaluation / assessment methods				

	17.1.	Tests		40 points
	17.2.	Individual tasks / project (presentation: written and oral)		10 points
	17.3.	Activity and participation		20 points
	17.4.	Final exam		30 points
18.	Assessment criteria (points / grade)		Up to 50 points	5 (five) (F)
			51 – 60 points	6 (six) (E)
			61 – 70 points	7 (seven) (D)
			71 – 80 points	8 (eight) (C)
			81 – 90 points	9 (nine) (B)
			91 – 100 points	10 (ten) (A)
19.	Eligibility for signature and taking the final exam		60% realization of pre-exam activities, i.e., 42 points from two tests, seminary or practical work, and regular participation to the organized activities.	
20.	Language of the study program		English	
21.	Quality assurance methods of the teaching process		Self-evaluation	

22. Literature

22.1. Mandatory literature

No.	Author	Title	Publisher	Year
1.	ICH Guidelines Q1A-Q1F	*Stability testing of new drug substances and products* *Stability testing: photostability testing of new drug substances and products* *Stability testing for new dosage forms* *Bracketing and matrixing designs for stability testing of new drug substances and products* *Evaluation for stability data* *Stability data package for registration application in climatic zones III and IV*	ICH	2003 1996 1996 2002 2003 2018
2.	Kim Huynh-Ba	*Handbook of Stability Testing in Pharmaceutical Development. Regulations, Methodologies, and Best Practices.*	Springer	2009
3.	Fenghe Qiu, Garry Scrivens,	*Accelerated Predictive Stability Fundamentals and Pharmaceutical Industry Practices*	Academic Press	2018

22.2. Additional literature

No.	Author	Title	Publisher	Year

		1.	Sanjay Bajaj, Saranjit Singh	*Methods for Stability Testing of Pharmaceuticals (Methods in Pharmacology and Toxicology)*	Humana	2018
		2.	Thorsteinn Loftsson	*Drug Stability for Pharmaceutical Scientists*	Academic Press	2014