



## CD 8.5.1 DISCIPLINE CURRICULUM

Edition: 06

Date: 20.09.2017

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### FACULTY OF PHARMACY STUDY PROGRAM 0916.1 PHARMACY CHAIR OF GENERAL CHEMISTRY

APPROVED

at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum

faculty of Pharmacy

Minutes No. 2 of 21.12.2017

Chairman, PhD, associate professor

Uncu Livia



APPROVED

at the Council meeting of the Faculty of Pharmacy

Minutes No. 2 of 22.12.2017

Dean of Faculty, PhD, associate professor

Ciobanu Nicolae



APPROVED

approved at the meeting of the chair of

General chemistry

Minutes No.4 of 30.10.2017

Head of chair, PhD, associate professor

Cheptanaru Constantin

## SYLLABUS

### DISCIPLINE STEREOISOMERISM AND ACTION OF MEDICINES

#### Integrated studies

Type of course: **Optional discipline**

Chisinau, 2017



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### I. INTRODUCTION

- **General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the professional / specialty training program**

The curriculum of Stereoisomerism and action of medicines as pharmacist qualification is a normative pedagogical document and a didactic tool for the efficient organization of the educational process, elaborated based on the Framework Program for Pharmaceutical Higher Education in the Republic of Moldova. Is based on the Charter of the State University of Medicine and Pharmacy "Nicolae Testemitanu", Organization rules of studies in higher education based on the National Credit Studies System, no. 1/8 of 06.04.2017. Organization rules for evaluation and academic performance in State University of Medicine and Pharmacy "Nicolae Testemitanu", no. 5/4 of 12.10.2016, coordinated with the curriculum of pharmaceutical subjects (pharmaceutical chemistry, pharmaceutical biochemistry, drug technology, pharmacology and clinical pharmacy).

- **Mission of the curriculum (aim) in professional training**

The aim of the discipline *Stereoisomerism and the action of the medicines* is the foundation of the notions of stereoisomerism, the acquisition of knowledge about the importance of the pure enantiomers of the pharmaceutical substances, compared to the racemic mixtures in the treatment of various diseases, knowledge that completes the professional training of future pharmacists.

- : Romanian
- Beneficiaries: students of the 3<sup>rd</sup> year, faculty of Pharmacy



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### II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		<b>S.06.A.059</b>	
Name of the discipline		<b>Stereoisomerism and the action of the medicines</b>	
Person(s) in charge of the discipline		Ph.D in chem., assistant prof. Constantin Cheptanaru, Globa Elena	
Year	<b>III</b>	Semester/Semesters	<b>V</b>
Total number of hours, including:			<b>30</b>
Lectures	<b>15</b>	Practical/laboratory hours	-
Seminars	<b>15</b>	Self-training	-
Clinical internship			
Form of assessment	<b>C</b>	Number of credits	<b>1</b>

### III. TRAINING AIMS WITHIN THE DISCIPLINE

*At the end of the discipline study the student will be able to:*

• **at the level of knowledge and understanding:**

- to know the theoretical bases of stereoisomerism of organic compounds.
- to know the specification of the relative configuration and absolute configuration of the stereoisomers.
- to understand the concept of chirality and its importance in the field of medicine.
- to understand the importance of pure enantiomers of drug substances, relative to racemic mixtures, on their pharmacological activity.

• **at the application level:**

- to determine the belonging of the stereoisomers to the stereochemical series D and L, or R and S.
- to apply the characterization of optical isomers according to optical activity, relative configuration and absolute configuration of the center of chirality.

• **at the integration level:**

- to appreciate the importance of stereoisomerism in the context of integration with the disciplines (pharmacology, pharmaceutical chemistry, toxicology, drug technology, pharmacognosy, etc.).



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### IV. PROVISIONAL TERMS AND CONDITIONS

Curriculum - organic chemistry.

Skills - for the good grasp of the course, students must have the ability to understand, learn and apply theoretical notions. Students should have the ability to make correlations between taught notions, between course and both practical and interdisciplinary. Thorough knowledge of the organic chemistry: structural isomerism, configurational isomerism and conformational isomerism of organic compounds. Student of the III<sup>rd</sup> year should possess: • knowledge of the language of instruction; • digital competences (use of the Internet, document processing, electronic tables and presentations, use of graphic programs); • ability to communicate and work in team; • qualities - tolerance, compassion, autonomy.

### V. THEMES AND ESTIMATE ALLOCATION OF HOURS

*Lectures, practical hours/ laboratory hours/seminars and self-training*

No. d/o	THEME	Number of hours	
		Lectures	Practical hours
1.	Brief history of molecular chirality. Classification and definition of terminology used in drug stereochemistry (isomerism, enantiomerism, diastereoisomerism, epimer, racemates and racemization, "meso" forms, chiral inversion, distomer, eutomer, enantioselective synthesis). The importance of chirality in pharmacology and current therapeutics.	3	3
2.	Ways of characterization of optical isomers (according to optical activity, relative configuration and absolute configuration of the chirality. <i>Cahn - Ingold - Prelog</i> convention (the order of priority of chirality center substitutes, examples). Fischer projection for representing the relative configuration. Relationship between the attribution of the S-R character (according to the <i>Cahn-Ingold-Prelog</i> convention) and D-L (according to the Fischer projection) (examples).	3	3
3.	The implications of stereochemistry in different therapeutic classes: hypnotic sedatives, general and local anesthetics, opioid analgesics, antidepressants, antiparkinsonian, non-steroidal anti-inflammatory drugs, bronchodilators and antihistamines, antiulcer drugs, preparations used in cardiology, adrenergic, antimycotic.	7	3
4.	Presentation of the "case" of Thalidomide and its metabolites. Biochemical route of metabolism of Thalidomide. In vivo transformation / racemization of the (R) -Ibuprofen (distomer) isomer into (S) -Ibuprofen (eutomer).	1	3
5.	Aspects about the discovery of new chiral drugs. Enantioselective enantiomeric preparation of chiral drugs and / or enantiomer separation. Enumeration of enantioselective chemical synthesis and transformation methods.	1	3
<b>Total</b>		<b>15</b>	<b>15</b>



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### VI. REFERENCE OBJECTIVES OF CONTENT UNITS

Objectives	Content units
<b>Chapter 1.</b> Theoretical basis of the stereoisomerism of organic compounds.	
<ul style="list-style-type: none"><li>to define isomerism, enantiomer, diastereoisomerism, epimer, racemates and racemization, "meso" forms, chiral inversion, distomer, eutomer.</li><li>to know the methods of characterization of optic isomers (after optical activity, relative configuration and absolute configuration of the chirality center.</li><li>to demonstrate the relationship between assigning the S-R character (according to the <i>Cahn-Ingold-Prelog</i> convention) and D-L (according to the Fischer projection).</li><li>to apply the classification and definition of the terminology used in the stereochemistry of drugs</li><li>to integrate the knowledge gained in the field with the needs of other disciplines in the field of drug chemistry</li></ul>	<ol style="list-style-type: none"><li>The Importance of Chirality in Pharmacy and Pharmacology. Types of isomers. Getting Chirality.</li><li>Stereoisomers: enantiomers and diastereomers. The relative and absolute nomenclature. The properties of the enantiomers.</li><li>Ways of characterization of optical isomers (after optical activity, relative configuration and absolute configuration of the chirality center. <i>The Cahn - Ingold - Prelog</i> Convention (the order of priority of chirality center substitutes, examples) <i>The Fischer</i> projection for the representation of the relative configuration. The relation between the attribution of the character SR (according to the <i>Cahn - Ingold - Prelog</i> convention) and DL (according to the Fischer projection)</li></ol>
<b>Chapter 2.</b> The implications of stereochemistry in different therapeutic classes	
<ul style="list-style-type: none"><li>To know the role of chirality in the therapeutic action of drugs, metabolic biotransformation.</li><li>to demonstrate stereochemical implications in different therapeutic classes.</li><li>to apply stereochemical notions in the development of new drugs.</li><li>to integrate the knowledge gained in the field with the needs of other disciplines in the field of drug chemistry and pharmacology.</li></ul>	<ol style="list-style-type: none"><li>The implications of stereochemistry in different therapeutic classes.</li><li>The importance of the pure enantiomers of the drug substances, compared to the racemic mixtures, on their pharmacological activity.</li><li>Aspects about the discovery of new chiral drugs. Enantioselective preparation of chiral drugs.</li></ol>



## VII. PROFESSIONAL (SPECIFIC (SC)) AND TRANSVERSAL (TC) COMPETENCES AND STUDY OUTCOMES

### ✓ Professional (specific) (SC) competences

PC1. Knowledge of the theoretical bases of the disciplines included in the curriculum of the faculty, general principles in the design, formulation, preparation and conditioning of pharmaceutical and para-pharmaceutical products.

PC2. Knowing the notions of stereochemistry related to different classes of drugs. Knowing the importance of drug chirality. Knowledge of the importance of stereochemistry in the process of obtaining new pharmaceutical substances. Knowledge of enantiodiscriminatory action of drugs and enantioselective toxicity of chiral drugs.

PC3. Adoption of messages in various socio-cultural environments, including through multi-language communication, use of problem solving capabilities through interdisciplinary correlation with other fundamental and specialized subjects: pharmaceutical chemistry, pharmacognosy, pharmacology, biochemistry, etc. the bibliographic documentation capacities, the synthesis of the obtained information.

### ✓ Transversal competences (TC)

TC1. Obtaining moral markers, forming professional and civic attitudes, allowing students to be honest, honest, nonconflict, cooperative, available to help people interested in community development;

TC2. Teamwork skills.

TC3. Using knowledge and skills in new contexts. Openness for continuous education, autonomy and responsibility, observance of professional ethics.

### • Study outcomes

- Understanding the concept of chirality and its importance in the field of medicine.
- Knowledge of aspects specific to the stereochemistry of drugs.
- Knowledge of enantiodiscriminatory action of drugs and enantioselective toxicity of chiral drugs.
- Knowledge of enantioselective methods of chiral drugs.



## VIII. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

- ***Teaching and learning methods used***

The discipline of *Stereoisomerism and the action of the medicine* is taught in classical ways: lectures, practical works. At the lectures, the theoretical course will be read by the course holders. Students acquire knowledge of the importance of pure enantiomers of pharmaceutical substances, as compared to racemic mixtures in the treatment of various diseases.

- ***Applied teaching strategies / technologies (specific to the discipline)***

To succeed in the discipline of *Stereoisomerism and the action of the medicine* the student should actively work both in courses and seminars, as well as in his own right, and the teacher should use the didactic technologies specific to the discipline. The most important methods in teaching organic chemistry are *problematization* and *brainstorming*.

*Brainstorming* is a technique of group creativity designed to generate a large number of ideas to solve a problem.

*Problematization* called and teaching through problem solving or, more specifically, teaching through productive problem solving. A didactic method consisting in putting in the minds of the students some deliberately created difficulties in overcoming which, by their own effort, the student learns something new.

- ***Methods of assessment (including the method of final mark calculation)***

***Current:*** front and / or individual control via

1. solving problems / exercises,
2. analysis of case studies
3. concluding tests.

***Final:*** colloquium

Colloquium in the discipline *Stereoisomerism and the action of the medicine* is a simple one. The final grade at the colloquium will be made up of the average grade of two concluding tests and individual work.



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### Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTSEquivalent
<b>1,00-3,00</b>	<b>2</b>	<b>F</b>
<b>3,01-4,99</b>	<b>4</b>	<b>FX</b>
<b>5,00</b>	<b>5</b>	<b>E</b>
<b>5,01-5,50</b>	<b>5,5</b>	
<b>5,51-6,0</b>	<b>6</b>	
<b>6,01-6,50</b>	<b>6,5</b>	<b>D</b>
<b>6,51-7,00</b>	<b>7</b>	
<b>7,01-7,50</b>	<b>7,5</b>	<b>C</b>
<b>7,51-8,00</b>	<b>8</b>	
<b>8,01-8,50</b>	<b>8,5</b>	<b>B</b>
<b>8,51-8,00</b>	<b>9</b>	
<b>9,01-9,50</b>	<b>9,5</b>	<b>A</b>
<b>9,51-10,0</b>	<b>10</b>	

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book.

*Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero). The student has the right to have two re-examinations.*





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### IX. RECOMMENDED LITERATURE:

#### A. Compulsory:

1. ZURABYAN S.E. *Fundamentals of bioorganic chemistry*. GEOTAR-Media publishing group, 2017.
2. STEVEN S. ZUMDAHL. *Chemistry*. Lexington, Massachusetts, Toronto, 1986.
3. FRANCIS MARION MILLER. *Chemistry, Structure and dynamics*. McGraw-Hill book company, USA., 1984.

#### B. Additional

1. NENIȚESCU C. D. *Chimie organică*. B.: "Regia Autonomă Monitorul Oficial", 2015.
2. ВОРОНКОВ Л. Г. *Клиническое использование хиральных молекул как новое направление в кардиоваскулярной фармакотерапии*. Киев: Национальный научный центр «Институт кардиологии им. Н.Д. Стражеско» АМН Украины.
3. НЕСУКАЙ Е. Г. *Левовращающий переворот в кардиологии, Артериальная гипертензия*. № 1(15), 2011, с.14-18.