# FACULTY OF PHARMACY

## STUDY PROGRAM 0916.1 PHARMACY

### DEPARTMENT OF PHARMACEUTICAL AND TOXICOLOGICAL 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**
at the meeting of the chair of Pharmaceutical and Toxicological Chemistry.
Minutes No. 3 of 03.11.2017
Head of chair PhD. professor
VALICA Vladimir

# SYLLABUS

DISCIPLINE **SOURCES AND METHODS OF OBTAINING OF DRUGS**

**Integrated studies**

Type of course: **Optional**

**Chisinau, 2017**

# 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**

***Sources and methods of obtaining of drugs*** is a discipline which integrating the knowledge of basic disciplines and show their value in rational drug design and synthesis. Knowledge about sources of drugs, principles of method selection, equipment and control particularities of obtained compounds, helps understanding the rational drug design through formation of cause-effect relationship. This knowledge is indispensable to get a job in pharmaceutical industry. At the same time, the understanding of the particularities of obtaining biological drugs correlates with the new requirements towards the professional skills of the future pharmacist.

The optional course ***Sources and methods of obtaining of drugs*** are proposed and recommended for the 2nd year of Pharmacy specialization.

The aim of the course ***Sources and methods of obtaining of drugs*** is to form pharmacists students a complex vision and skills in rational design and synthesis of drugs, developing the self-training skills to meet professional requirements.

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

To provide students with knowledge on the sources of medication, as well as to develop skills to understand the processes and methods of rational drug design.

- **Language (s) of the course:** Romanian, Russian, English.
- **Beneficiaries:** students of the II year, faculty Pharmacy, specialty PHARMACY.

## II. MANAGEMENT OF THE DISCIPLINE

| | | | |
|---|---|---|---|
| Code of discipline | | **S.03.A.036** | |
| Name of the discipline | | **Sources and methods of obtaining of drugs** | |
| Person(s) in charge of the discipline | | PhD in Pharmaceutical Sciences, associate professor **Livia Uncu** | |
| Year | **II** | Semester | **3** |
| Total number of hours, including: | | | **60** |
| Lectures | **17** | Practical/laboratory hours | |
| Seminars | **34** | Self-training | **9** |
| Form of assessment | **C** | Number of credits | **2** |

## 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:***

- aim of study of the discipline;
- objectives of the discipline;
- theoretical bases and essence of methods of synthesis of chemical and biological drugs.

- ***at the application level:***

- chemical classification of medicines in pharmaceutical practice;
- to distinguish the theoretical bases and the essence of the methods of chemical synthesis, semi-synthesis and medical bioengineerings;
- apply modern methods of synthesis;
- calculate the yield, purity and other statistical parameters of the obtained products.

- ***at the integration level:***

- to draw up the current documentation on chemical synthesis;
- knowledge of the quality of synthetic and biological drugs according to the provisions of the DAN.

## IV. PROVISIONAL TERMS AND CONDITIONS

Study of this course requires knowledge of general chemistry, inorganic, biology, botany previously accumulated, and the foundation of other specialized disciplines such as toxicology chemistry, pharmaceutical chemistry, medicinal chemistry.

## V. THEMESAND ESTIMATEALLOCATION OF HOURS

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

| Nr. d/o | THEME | | Number of hours | | |
|---|---|---|---|---|---|
| | | | Lectures | Seminars | Self-training |
| 1. | **Drug sources and synthesis methods. Fundamental concepts** | The main stages in the creation of drugs. Relationship between the structure of the substance molecule and its action on the body. | 2 | 2 | - |
| | | Natural drug sources and synthesis methods . Empirical and guided searching. | 1 | 2 | - |
| 2. | **Chemical Synthesis of Drugs** | Principles of Chemical Synthesis and Methods Used. Sources, reagents, devices and required conditions for obtaining synthetic drug. | 2 | 4 | - |
| | | Synthesis of the main classes of drugs (inorganic, aliphatic, alicyclic, aromatic, heterocyclic compounds). | 2 | 4 | 2 |
| | | Organic chemistry calculation | - | 2 | 2 |
| 3. | **Semisynthetic drugs** | Semisynthesis methods. Sources, reagents, equipment and conditions required for obtaining medication. | 2 | 4 | - |
| | | Synthesis of antibiotics. Penicillins of biosynthesis and of semi synthesis. | 2 | 2 | 2 |
| | *Control assessments.* | | - | 2 | - |
| 4. | **Drugs derived from plant and animal sources** | Plant and animal sources and methods of obtaining drug substances. | 2 | 2 | - |
| | | Medicines and food supplements of plant and animal origin | - | 2 | 2 |
| 5. | **Biological Medicines** | Biological drugs. Sources and particularities of synthesis. Preparations of animal extracts. Hormonal biological drugs. Blood and products derived from blood. Vaccines. Immunological products. | 4 | 4 | 1 |
| | *Control assessments.* | | - | 2 | - |
| 6. | ***Colloquium*.** | | - | 2 | - |
| **Total** | | | **17** | **34** | **9** |

## VI. REFERENCE OBJECTIVES OF CONTENT UNITS

| Objectives | Content units |
|---|---|
| **Theme (chapter) 1. Sources and methods of obtaining the drug. Fundamental concepts.** | |
| • To define the basic concepts of discipline;<br>• to know the drug sources;<br>• to demonstrate the ability to analyze and systematize the theoretical knowledge;<br>• to apply the criteria for differentiating the methods used in the rational design of medicines. | Fundamental concepts of discipline.<br>Drug sources.<br>Synthesis method, apparatus and reagents required to obtain drugs.<br>Criteria for differentiating the methods used in the rational drug design. |
| **Theme (chapter) 2.Chemical synthesis of drugs.** | |
| • To argue the choice of synthesis method;<br>• to identify the reagents, laboratory utensils and apparatus necessary to achieve the proposed synthesis;<br>• to know the theoretical bases for calculating the quality index of the new substance;<br>• to apply the knowledge acquired to solve the problems and tasks proposed. | Calculation formulas of the main parameters describing the synthesis.<br>Requirements for achieving stereo chemical control in drug synthesis.<br>Relationship activity structure of the main classes of drugs (inorganic, aliphatic, alicyclic, aromatic, heterocyclic compounds). |
| **Theme (chapter) 3. Semi synthetic drugs.** | |
| • To define the notions: biosynthesis, microorganism, antibiotic, nutritive medium, activity unit;<br>• to argue for the choice of the microorganism, the culture medium for obtaining a particular compound;<br>• to identify reagents, laboratory utensils, and the equipment needed to achieve the proposed biosynthesis;<br>• to know the theoretical bases for purification and calculation of the quality index of the new substance;<br>• to apply the knowledge acquired to solve the problems and tasks proposed. | Processes and methods to optimize the activity structure relationship. Examples<br>Conditions necessary for carrying out the biosynthesis and stereo-chemical control of obtained compounds.<br>The structure relationships of penicillins, cephalosporins, macrolides, polyenes, etc. |
| **Theme (chapter) 4. Drugs derived from plant and animal sources.** | |
| • To define the notion of medicinal herb, extraction, phytotherapeutic product, immunogenicity, physical stability, | Particularities of obtaining, purifying and storage conditions of the natural compounds in the laboratory. |

| Objectives | Content units |
|---|---|
| microbiological stability, chemical stability, food supplement;<br>• to know the way of working, the conditions of deployment, the particularities of purification and storage of the obtained compounds;<br>• to demonstrate analytical skills for analytical documentation and scientific studies. | Formulas for calculating the main parameters of synthesis. The practical role of these parameters. The importance of knowledge by the pharmacist. |
| **Theme (chapter) 5. Biological Drugs.** | |
| • To define and describe the main notions: biopharmaceuticals, biosimilar, bioscientists;<br>• to know the classification of biological drugs<br>• to explain the influence of different factors on the stability of biological drugs;<br>• to propose a reasoned opinion regarding the use of vaccines;<br>• to demonstrate critical analysis skills during case studies. | Particularities of obtaining biopharmaceuticals.<br>Methods of control and standardization of biopharmaceuticals.<br>Immunogenicity and procedures to minimize this phenomenon.<br>Case studies discussion. |

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

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

- PC1. Operation with notions of structure, properties and reactivity of chemical and pharmaceutical compounds.
- PC2. Use of techniques and methods of analysis and investigation of pharmaceutical compounds.
- PC3. Performing experiments, rigorous application of methods of analysis and interpretation of results, elaboration of protocols for physic-chemical analysis of some chemical and pharmaceutical products.
- PC4. Professional possession of the theoretical principles of rational drug development.
- PC5. Laboratory management and quality assurance

### ✓ Transversal competences (TC)

- TC1. Apply rigorous and efficient work rules to optimally and creatively capitalize their own potential in specific situations, respecting the principles and norms of professional ethics.
- TC2. Critical identification, description and analysis of concepts, approaches, theories, methods and models specific to the structure and reactivity of chemical and

pharmaceutical compounds.

- TC3. Appropriate use of laboratory methods and apparatus in the identification and analysis of pharmaceutical compounds.

## ✓ Study outcomes

Upon successful completion of the course the student will be able to:

- to know the general methods and procedures of rational design of the drug, the factors that influence the action of the drug, the biological drugs;
- Describe the synthetic steps of some drug compounds;
- be able to identify and avoid the main types of errors commonly encountered in obtaining medication;
- Detect and contribute to the exclusion of drug interactions, which may have a negative impact on the patient's health.

**Note. Study outcomes** (are deduced from the professional competencies and formative valences of the informational content of the discipline).

## VIII. STUDENT'S SELF-TRAINING

| No. | Expected product | Implementation strategies | Assessment criteria | Implementation terms |
|---|---|---|---|---|
| 1. | Working with lecture materials, methodical indication | Work systematically in the library and mediate.<br>Exploring the current electronic sources on the topic under discussion | 1. Quality of formed judgments, logical thinking, flexibility.<br>2. The quality of the systematization of the informational material obtained through its own activity. | During the semester |
| 2. | Report | Analysis of relevant sources on the topic of the paper.<br>Analysis, systematization and synthesis of information on the proposed theme.<br>Compilation of the paper according to the requirements in force and presentation to the chair. | 1. The quality of systematization and analysis of the informational material obtained through its own activity.<br>2. Concordance of information with the proposed theme.<br>3. Quality of PPT presentation and answers to questions. During the semester | During the semester |

| | | | | |
|---|---|---|---|---|
| 3. | Case study analysis | Choice and description of the case study<br>Analysis of the causes of the issues raised in the case study.<br>Prognosis of the case investigated.<br>Deduction of the expected outcome of the case. | 1. Ability to analyze, synthesize, generalize data obtained through its own investigation.<br>2. Formation of an algorithm of knowledge based on the obtained conclusions. | During the semester |

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

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

Exposure, interactive lecture, heuristic conversation, problem-solving, brainstorming, group work, individual study, work with textbook and text, debate, problem solving, role play, simulation, interactive listening**.**

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

***Inductive, deductive strategies***, teaching and learning strategies are developed using models (analogue strategies), algorithmic strategies: explicative-demonstrative, intuitive, exponential, imitative and algorithmic; heuristic strategies - to develop knowledge through his or her own thinking effort, using problem-solving, discovery, modeling, hypothesis formulation, heuristic dialogue, investigative experiment, assault of ideas, which stimulate creativity.

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

**Current:** front and / or individual control via:
(a) application of docimological tests;
(b) solving problems / exercises;
(c) analysis of case studies;
(d) playing role plays on the topics discussed;
(e) control assesments – 2:
(f) the current assessment of self-training at the end of the semester.

**The average mark** is calculated by average of the marks obtained at control assesments and the mark of self-training.

**Final:** Colloquium, the "certified" rating - test-control and oral answer.

The final grade at the colloquium will be composed of the average score during the semester (50%), the test-control and oral answer (50%).

*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.*

## X. RECOMMENDED LITERATURE:

### *A. Compulsory:*

1. Course support.
2. Abraham D.J., *Burger's medicinal chemistry and drug discovery*, 6th ed., vol I – VI, Wiley & Sons Inc. – pe CD.
3. Methodical indications.

### *B. Additional*

1. Lista medicamentelor esenţiale. Ordinul MS RM Nr. 162 din 23.04.07.
2. P.Y. Bruice. Organic chemistry. Prentice Hall, 2011 - Science. Sixth edition. 2. J. Clayden, N. Greeves, S. Waren, P. Wothers. Organic chemistry. Oxford University Press, 2001, ISBN 0198503466.
3. E. J. Corey, X-M. Cheng. The Logic of Chemical Synthesis. New York: Wiley, 1995, ISBN 0-471- 11594-0.
4. Matcovschi C., Safta V. Ghid farmacoterapeutic (medicamente omologate în Rep. Moldova) – 2010, Chişinău, 1340 p.
5. Block J.H., Beale J.M., *Wilson and Gisvold's, Textbook of Organic Medicinal and Pharmaceutical Chemistry*, ed. a XI-a, Ed. Lippincott Williams &Wilkins, 2004 – pe CD
6. Mureşan A., Palage M. *Chimie Terapeutică. Medicamente utilizate în afecţiuni cardiovasculare*, Ed. Accent, Cluj-Napoca, 2000.
7. Mureşan A., Palage M. *Medicaţia afecţiunilor sistemului nervos central*, Ed. Medicală Universitară Iuliu Haţieganu, Cluj-Napoca, 2006.
8. Oniga O., Tiperciuc B. *Antiseptice şi dezinfectante*, Ed. Medicală Universitară Iuliu Haţieganu, Cluj-Napoca, 2002.
9. Oniga O., Tiperciuc B. *Antibiotice antibacteriene*, Ed. Medicală Universitară Iuliu Haţieganu, Cluj-Napoca, 2003.
10. Neidle S. *Cancer Drug Design and discovery*, Elsevier Inc., 2008 – pe CD.
11. Newton D. *Chemistry of drugs*, Fact on File Inc., New York, 2007.
12. Williams D.A., Lemke T.L. *Foye's principles of Medicinal Chemistry*, ed. a V-a , Ed. Lippincott Williams & Wilkins, 2002 – pe CD.
13. Ziwei H. *Drug discovery research. New frontiers in the post-genomic era*, Wiley Interscience, 2007 – pe CD.