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 09.11.2021

Chairman, PhD, associate professor

Uncu Livia _____

APPROVED
at the Council meeting of the Faculty of Pharmacy
Minutes No. 3 of 16.12.2021

Dean of Faculty, PhD, associate professor

Ciobanu Nicolae _____

APPROVED

approved at the meeting of the chair of

General chemistry
Minutes No. 3 of 10.09.2021
Head of chair, PhD, associate professor

Cheptanaru Constantin _____

SYLLABUS

DISCIPLINE **COMPLEX COMPOUNDS WITH APPLICATION IN PHARMACY**

Integrated studies

Type of course: **Optional discipline**

Syllabus was elaborated by:

Melnic Silvia, PhD, associate professor.

Chisinau, 2021

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**

Curriculum *Complex compounds with application in pharmacy* for pharmacist qualification is a normative pedagogical document and a didactic tool for the efficient organization of the educational process. At the Nicolae Testemitanu State University of Medicine and Pharmacy the curriculum development is based on several normative regulatory documents: Framework Program for Pharmaceutical Higher Education in the Republic of Moldova, based on the University Charter of PI Nicolae Testemitanu SUMPh, Regulations for organization of studies in higher education based on the National Credit Studies System, no. 1/8 of 06.04.2017, Regulation for evaluation and academic performance in the Nicolae Testemitanu State University of Medicine and Pharmacy, no. 5/4 of 12.10.2016, coordinated with the curriculum of pharmaceutical disciplines (pharmaceutical chemistry, pharmaceutical biochemistry, drug technology, pharmacology and clinical pharmacy).

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

Discipline *Complex compounds with application in pharmacy*, aims to acquire basic knowledge in the field of modern coordinative chemistry and to understand its close relationship with pharmaceutical chemistry, drug analysis, catalysis, biochemistry. The task of the discipline is to familiarize the student with modern concepts about coordination compounds, the relationship between the structure and reactivity of different types of coordination compounds, and their areas of use.

- Languages of the course: Romanian, Russian, English
- Beneficiaries: students of the 2nd year, faculty of Pharmacy

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		**S.04.A.038.1**	
Name of the discipline		**Complex compounds with application in pharmacy**	
Person(s) in charge of the discipline		Ph. D in chem., assistant prof. Melnic Silvia	
Year	**II**	Semester/Semesters	**IV**
Total number of hours, including:			**60**
Lectures	**15**	Practical/laboratory hours	**-**
Seminars	**30**	Self-training	**15**
Form of assessment	**E**	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:***

  • Appreciate the importance of complex compounds for the design, analysis and study of medicinal substances;

  • To describe the physical-chemical properties of the coordination compounds used as active principles of drugs;

  • To explain the relationship between composition, structure, biological activity and the therapeutic effect of coordination compounds;

  • Describe coordination compounds used in drug analysis;

  • Describe coordination compounds used in the design and preparation of drugs.

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

  • To use basic knowledge in the field of coordination chemistry for the quantitative analysis of medicinal substances;
  • To apply the characteristic reactions of the coordination compounds to the identification of the composition of the medicinal substances;
  • To interpret and present correctly the experimental results obtained;
  • To plan the stages of synthesis and study of coordination compounds.

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

• To express one's point of view and argue one's position;
• To apply the specialized language in formulating the answers to the questions;

- To develop social skills of interaction with others;
- To select and apply the knowledge gained in solving problems;
- To formulate conclusions and recommendations.

IV. PROVISIONAL TERMS AND CONDITIONS

Curriculum - inorganic chemistry, analytical chemistry.
Competences - for the good acquisition of the course, students should have the ability to understand, learn and apply the theoretical notions practically;
Students should have the ability to make correlations between the notions taught, between the course and the practical works, as well as interdisciplinary. Thorough knowledge in the field of Inorganic Chemistry, Analytical Chemistry, Organic Chemistry is required.
The second year student must possess the following abilities:
- knowledge of the language of instruction;
- digital skills (internet use, document processing, electronic tables and presentations);
- ability to communicate and work in a 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	Individual hours
1.	General notions of coordination chemistry: complex compound, complex generator (central atom), ligands, coordination number. Formulation and nomenclature of complex combinations. Classification. Isomerism. Stability.	2	4	2
2.	The chemical bond in coordinative compounds. Valence bonding method. Crystalline field theory.	2	3	2
3.	Reactivity of coordination compounds. Methods of synthesis of complex compounds.	1	4	1
4.	Biocomplexes.	2	3	2
5.	Application of coordination compounds in the qualitative and quantitative chemical analysis of medicinal substances.	2	4	2
6.	Complex compounds as drugs.	2	4	2
7.	Synthesis and study of new coordination compounds with improved activity.	2	4	2
8.	Methods of investigation of coordination compounds: IR spectroscopy, UV-vis, X-ray, magnetochemistry, thermogravimetry, etc.	2	4	2
Total		**15**	**30**	**15**

VI. REFERENCE OBJECTIVES OF CONTENT UNITS

Objectives	Content units
Chapter 1. General notions of coordination chemistry. Biocomplexes.	
• To define the notions of a complex, ligand, complex former. • to know and understand the phenomena, terminology and concepts specific to coordination chemistry. • to apply the knowledge regarding the reactivity of the coordination compounds to explain the particularities of the chemical behavior of these compounds • to know the structures and biological activity of complex compounds in biological systems. • to integrate the gained knowledge with the needs of other disciplines in the field of biochemistry and drug chemistry.	• General notions of coordination chemistry. A. Werner's coordination theory. The notion of classical type of coordination compound. Central atom, ligand. Nomenclature, formulation and classification of coordination compounds. Stereochemistry of complex combinations. Coordination numbers and coordination polyhedra. Monodentate, bidentate, polydentate, macrocyclic ligands. Isomerism of coordination compounds. • Chemical bonding in coordination combinations. Valence bonding method. Crystalline field theory. Cleavage of orbitals in the tetrahedral and octahedral fields. Stabilization energy in the crystalline field. Color and magnetic properties of coordination compounds. Formation and stability of coordination compounds. Stability constant. The chelating effect. • Reactivity of coordination compounds. Hydrolysis reactions, substitution reactions, addition reactions. Oxidation-reduction reactions. Methods for the synthesis of coordination compounds. • Biocomplexes. Metal-porphyrin. Hemoproteins. Hemoglobin and myoglobin. Metal-corine chlorophyll. Vitamin B12. Load-carrying compounds.
Chapter 2. Application of coordination compounds in pharmacy and medicine.	
• To form some practical skills and abilities	• Application of coordination

Objectives	Content units
necessary to determine the physical-chemical parameters of medicinal substances using coordination compounds. • Know the coordination compounds used in the design and preparation of drugs. • Know the complex combinations that can remove metal ions from the body when they occur in amounts that are toxic. • To apply the gained knowledge to establish the relationship between chemical structure and therapeutic action. • Understand ways to find new compounds with improved activity, low toxicity or that solve the problem of resistance.	compounds in the qualitative and quantitative chemical analysis of medicinal substances. • Medical applications of coordination compounds. Toxic effects of metals. Anti-cancer and anti-rheumatic agents. Radionuclides. • Synthesis and study of new coordination compounds with improved activity. • Methods of investigation of the coordination compounds: IR spectroscopy, UV-vis, X-ray, magnetochemistry, thermogravimetry, etc.

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

✓ Professional (specific) (SC) competences

• SC1. Knowledge of the theoretical bases of the disciplines included in the faculty curriculum, of the general principles in the design, formulation and preparation of pharmaceutical products. Operating with notions of structure and reactivity of coordination compounds.

•SC2. Knowledge of coordination combinations basics with importance in pharmacy. Carrying out experiments, applying methods and techniques of qualitative and quantitative analysis with the use of coordination compounds, interpreting the results of chemical analysis of medicinal substances.

• SC4. Ability to apply in professional activity the theoretical knowledge acquired.

• SC6. The use of the capacities to solve the situation problems through an interdisciplinary correlation with the other fundamental and specialized subjects: pharmaceutical chemistry, pharmacognosy, biochemistry, etc., the development of the capacities of bibliographic documentation, of synthesis of the obtained information.

✓ Transversal competences (TC)

• TC1. Acquisition of new scientific knowledge and professional development through their efficient use. Acquiring moral landmarks, forming professional and civic attitudes that allow students to be fair, honest, non-conflicting, cooperative, available to help people, interested in community development;

• TC2. Knowledge and application of ethical principles related to medical-pharmaceutical practice; the ability to recognize a problem when it arises and provide reasonable solutions to solve it.

• TC3. Use of knowledge and skills in new contexts. Openness to continuing education, autonomy and responsibility, respect for professional ethics.

• Study outcomes

• Knowledge of the physical-chemical properties of complex combinations used as active principles of drugs. Design of new complexes with improved activity.

• Knowledge of the relationship between the composition, structure and biological activity of coordination compounds.

• Application of basic knowledge in the field of coordination chemistry required for qualitative and quantitative chemical analysis of medicinal substances.

• Applying the knowledge gained for processing drug analysis data.

VIII. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources	Careful reading of the assigned material before of each theoretical and practical lesson. Read the text-book in order to participate in class discussion, better follow the lecture, and ask meaningful questions. Reflect on the content as you read and take notes. Study worked out examples, which provide further illustration the ideas explained in text. Answer the questions. Prepare some instructions, notes as well as questions prior to arriving in the lab or in the class. Make acquaintance with supplementary bibliography units from the field of the studied discipline. Summarize and take notes in your own words to help you understand and retain information. Don't rely on highlighting as your main method of note-taking	Ability to extract the essentials, ability to survey the topics and concepts being studied; ability to review and reflect on the concepts that studied.	Throughout the semester
2.	Working problems	Solve the assigned problems. Working on problems in the book and other sources is an ideal way to prepare for chemistry disciplines.	Ability to work problems independently and correctly (not memorization). Achieving final answers that are completely correct is important.	Throughout the semester
3.	Working scientific essay	Select the topic and analyze it. The essay purpose should be unambiguously defined. Prepare a detailed outline of the essay and basic bibliography.	The primary function of an assessment essay is to document what a student has learned. The higher	Throughout the semester

		Write definitions for each of the key terms. Start on the reading list, tacking the more general textbooks first and moving on the more specialized books, review articles etc. Take notes when reading. Working of the essay. Once the essay is finished it should be submitted to the lecturer.	quality student's essay the greater the progress the student will make in the session. Assessment student understanding; judgment about student achievement at certain relevant points in the learning process of study.	

IX. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

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

Discipline *Complex compounds with applications in pharmacy* is taught in the classical way: with lectures, practical works (seminars). The lectures will be read during the theoretical course. The practical works consist in applying the knowledge accumulated to solve problems, explaining the processes and phenomena taught in the course, identifying the classes of coordination compounds (classical coordination compounds, biocomplexes, etc.) based on their properties. Laboratory work aims to train working skills in the chemistry laboratory; handling of chemical utensils and laboratory apparatus; selection and preparation of reagents, laboratory utensils and equipment for qualitative determinations; planning and carrying out a chemical synthesis, etc.

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

In order to be successful in acquiring the discipline Complex compounds with applications in pharmacy, the student must work actively both in courses and seminars, as well as independently, and the teacher to use teaching technologies specific to the discipline. The most important methods in teaching this discipline are problematization and brainstorming.

Brainstorming is a group creativity technique, meant to generate a large number of ideas to solve a problem.

Problematization also called teaching through problem solving or, more precisely, teaching through productive problem solving. A didactic method that consists in putting in front of the student some difficulties deliberately created in overcoming which, through his 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. current quiz.

***Final**:*

Exam (semester IV).

Examination in the discipline *Complex compounds with applications in pharmacy* is test-grid. The final mark of the exam will consist of the annual average mark and the grid test.

Students with an annual average below grade 5, as well as students who have not recovered their absences from practical work are not admitted to the exam. The average grade is calculated from the grades from a quiz paper and the individual work.

Method of mark rounding at different assessment stages

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

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.

X. RECOMMENDED LITERATURE:

A. Compulsory:

1. STEVEN S. ZUMDAHL. *Chemistry*. Lexington, Massachusetts, Toronto, 1986.
2. FRANCIS MARION MILLER. *Chemistry, Structure and dynamics.* McGraw-Hill book company, USA, 1984.

B. Additional

1. NELSON P.G. *Introduction to Inorganic chemistry: Key ideas and their experimental bases.* Peter G. Nelson and Ventus Publishing Aps, 2011.
2. STROHFELDT, A. KATJA. *Essentials of inorganic chemistry: for students of pharmacy, pharmaceutical sciences and medicinal chemistry*. John Wiley & Sons, Ltd 2015.