

Danylo Halytsky Lviv National Medical University
Department of Pharmaceutical, Organic and Bioorganic chemistry

SYLLABUS FOR
“MODERN METHODS OF RESEARCH OF BIOLOGICAL SYSTEMS”

Second (master's) educational level
Field: 22 " Healthcare "
Specialty 226 " Pharmacy, industrial pharmacy"

| 1. General information | |
|---|---|
| Faculty | Pharmaceutical |
| Program | 22 Healthcare, 226 Pharmacy, industrial pharmacy the second (master's) level, full-time |
| Academic year | 2020/2021 |
| Subject | Modern methods of research of biological systems, OK 14, Kaf_pharmchemistry@meduniv.lviv.ua |
| Department | Department Pharmaceutical, Organic and Bioorganic chemistry Pekarska 69, Lviv, Tel. +38(032)275-59-66, 275-59-77, 278-64-34 Kaf_pharmchemistry@meduniv.lviv.ua |
| Head of Department | Lesyk Roman, Doctor of Science, Professor roman.lesyk@gmail.com |
| Year of study | Third |
| Semester | Fifth |
| Type of course / module | Elective |
| Professors | Holota Serhii, PhD, Associate Professor, golota.serg@gmail.com Inna Demchuk, PhD, Associate Professor, Olha Novikevych, PhD, Senior lecturer |
| Erasmus yes/no | No |
| The person responsible for the syllabus | Olha Novikevych, PhD, Senior lecturer |
| Number of credits ECTS | 3 |
| Number of hours | 90 (Lectures – 20 hours, Practical classes – 60 hours, Out of class work – 90 hours) |
| Language of study | English |
| Information about consultations | On schedule |
| Address, telephone and regulations of the clinical base, office ... (if necessary) | - |
| 2. Short annotation to the course | |
| <p>The discipline "Modern methods of research of biological systems" belongs to the elective disciplines of the cycle of professionally-oriented training of specialists in the specialty "Pharmacy". Modern methods of studying biological systems, as a science based on the general laws of chemical sciences, studies the chemical and physical properties of drugs, the relationship between chemical structure and action on the body. The discipline "Modern methods of research of biological systems" is the basis for the study of drugs, understanding their action and practical activities of specialists in pharmaceutical specialties.</p> | |
| 3. The purpose and objectives of the course | |
| <p>1. Objectives of teaching of the "Modern methods of research of biological systems" course is:</p> <ul style="list-style-type: none"> - to provide systematic knowledge on the identification and quantification, physical, physicochemical and chemical properties, chemical factors of pharmacological action, patterns of relationship structure - biological / pharmacological activity and metabolic transformations of medicines. <p>2. The purpose of the "Modern methods of research of biological systems" course are:</p> <ul style="list-style-type: none"> - acquisition of skills in the field of providing quality pharmaceutical care to patients, taking into account knowledge of physical, physicochemical and chemical properties of drugs, the basic patterns of dependence "structure-activity". <p>3. Competences and learning outcomes, the formation of which provides the study of the discipline.</p> | |

3K – General competencies, ФК – Special responsibility

General competencies:

3K 2. The ability to apply knowledge in practical situations.

3K 6. Knowledge and understanding of the subject area and comprehension of the profession.

3K 11. Ability to assess and ensure the quality of performed work.

3K 12. Ability to perform research at the appropriate level.

Special responsibility:

ФК 4. Ability to ensure the rational use of prescription and over-the-counter drugs and other pharmaceutical products in accordance with the physicochemical, pharmacological characteristics, biochemical, pathophysiological features of a particular disease and pharmacotherapeutic regimens for its treatment.

ФК 7. Ability to ensure proper storage of medicines and other products of the pharmacy range in accordance with their physicochemical properties and the rules of Good Storage Practice (GSP) in health care facilities.

ФК 19. Ability to organize and control the quality of medicines in accordance with the requirements of the current State Pharmacopoeia of Ukraine and good practices in pharmacy, determine methods of sampling for control of medicines and standardize them in accordance with current requirements, prevent the spread of counterfeit medicines.

ФК 20. Ability to develop methods for quality control of medicines, including active pharmaceutical ingredients, medicinal plant raw materials and excipients using physical, chemical, physicochemical, biological, microbiological, pharmacotechnological and pharmacoorganoleptic control methods.

4. Pre-details of the course

Basic knowledge and learning outcomes are based on the study of the chemical structure of drugs, their physical and chemical properties; as well as methods for obtaining and purifying drugs, biologically active compounds and their metabolites. Interdisciplinary links: general and inorganic chemistry, organic and bioorganic chemistry, analytical chemistry, biophysics, biology, biological chemistry, normal physiology, pathological physiology, pharmacology, toxicological chemistry, pharmacognosy, drug technology, clinical pharmacy, drug standardization.

5. Program learning outcomes

List of learning outcomes

| Learning outcome code | The content of the learning outcome | Reference to the code of the competence matrix |
|--|---|---|
| 3H – Knowledges УМ – skills AB – independence and responsibility K – competence | | ППH – program learning outcomes |
| 3H-1 | basic principles of classification, nomenclature, structural and spatial isomerism of bioorganic compounds | ППH 1, ППH 3, ППH 5, ППH 8, ППH 9 |
| 3H-2 | types of chemical bonds, conjugate systems, electronic effects, acidity and basicity of bioorganic compounds as a basic basis of their reactivity | ППH 2, ППH 12 |
| 3H-3 | principles of classification of organic reactions according to the direction, method of bond disconnection and mechanism of their course | ППH 2, ППH 12 |
| 3H-4 | structure, nomenclature, isomerism, chemical properties and biological role of hydrocarbons, halogen-, oxygen-, sulfuro- and nitrogen-containing derivatives of hydrocarbons, heterofunctional compounds, | ППH 4, ППH 12, ППH 13, ППH 14, ППH 16, ППH 17, ППH 30, ППH 32 |

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| | heterocyclic compounds, biopolymers and bioregulators | |
| ЗН-5 | names and purpose of chemical and laboratory equipment | ППН 32 |
| УМ-1 | use chemical and reference literature, work with tabular and graphic data | ППН 4, ППН 9 |
| УМ-2 | to make separate laboratory installations | ППН 30, ППН 32 |
| УМ-3 | purify liquid and solid organic compounds, establish their purity | ППН 30, ППН 32 |
| УМ-4 | determine the physical constants of organic compounds | ППН 17, ППН 30, ППН 32 |
| УМ-5 | to conduct elemental analysis | ППН 14, ППН 17, ППН 30, ППН 32 |
| УМ-6 | use laboratory methods of obtaining individual organic compounds | ППН 30, ППН 32 |
| УМ-7 | to carry out qualitative reactions to multiple bonds and the main functional groups; | ППН 10, ППН 30, ППН 32 |
| УМ-8 | independently carry out the synthesis and analysis of the proposed organic compound | ППН 10, ППН 30, ППН 32 |
| К-1 | have a scientific worldview and creative thinking | ППН 12 |
| К-2 | have information management skills | ППН 9 |
| АВ-1 | have the ability to critically evaluate the results of their own research | ППН 12 |
| АВ-2 | be able to improve their own learning | ППН 4 |
| АВ-3 | be able to learn new areas through self-study, using the acquired knowledge of organic chemistry | ППН 4 |

| 6. Format and scope of the course | | | | |
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| Format of the course | | Full-time course | | |
| Type of lessons | | Number of hours | Number of groups | |
| lectures | | 10 | 1 | |
| practical | | 20 | 1 | |
| seminars | | - | - | |
| out of class work | | 30 | 1 | |
| 7. Topics and content of the course | | | | |
| Class type code | Topic | Content of training | Code of result of training | Professor |
| Л – lecture, П – practical class, CPC – out of class work | | | | |
| Л-1 | Biological systems. Influence of biologically active substances on biological systems of | Introduce students to the concept of biological systems. | ЗН 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |

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| | different level of hierarchy, methods of its estimation. | | | |
| Л-2 | Characteristics of physicochemical methods used in the analysis of drugs. "Physico-chemistry of drugs'action". Chromatographic research methods. | To acquaint students with the characteristics of physico-chemical methods used in the analysis of drugs. | ЗН 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| Л-3 | Spectroscopic and spectrometric methods of analysis. nuclear magnetic resonance spectroscopy, electronic paramagnetic resonance, infrared spectroscopy, UV spectroscopy, atomic adsorption spectrometry. | To acquaint students with spectroscopic and spectrometric methods of analysis | ЗН 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| Л-4 | Mass spectrometry. Combination of chromatographic and spectrometric methods. | To acquaint students with the concept of mass spectrometry. | ЗН 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| Л-5 | Methods of thermal analysis and calorimetric methods of analysis of solid forms. | To acquaint students with the methods of thermal analysis and colorimetric methods of analysis of solid forms . | ЗН 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| П-1 (практичне заняття 1) | Biological systems. Influence of biologically active substances on biological systems of different level of hierarchy, methods of its estimation. | To acquaint students with the concept of biological systems. | ЗН 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| П-2 | High performance liquid chromatography: basics, use | Introduce students to the concept of high performance liquid chromatography | ЗН 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| П-3 | Infrared spectroscopy, UV | Introduce students to the concept of high performance liquid chromatography | ЗН 1-4,6,8,9 | Holota S, PhD, Associate |

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| | spectroscopy, atomic adsorption spectrometry | | УМ 1,5,7- 9,10,11 | Professor |
| П-4 | Electronic paramagnetic resonance, principles, features, use. | To acquaint students with the concept of electronic paramagnetic resonance. | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| П-5 | Nuclear magnetic resonance spectroscopy, basics, principles of use | To acquaint students with the concept of nuclear magnetic resonance spectroscopy | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| П-6 | Mass spectrometry in the search for new drugs and drug research | To acquaint students with the concept of mass spectrometry | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| П-7 | Combination of chromatographic and mass spectrometric methods | To acquaint students with the peculiarities of the combination of chromatographic and mass spectrometric methods in the analysis of drugs. | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| П-8 | Methods of near-infrared spectroscopy | To acquaint students with the methods of spectroscopy in the near infrared region | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| П-9 | Crystallographic methods | To acquaint students with crystallographic methods of drug analysis. | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| П-10 | Methods of thermal analysis and calorimetric methods of analysis | To acquaint students with methods of thermal analysis and calorimetric methods of analysis. | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| CPC-1 (самоці йна робота 1) | Biological systems. Influence of biologically active substances on biological systems of different level of hierarchy, methods of its estimation. | To acquaint students with the concept of biological systems. | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| CPC-2 | High performance liquid chromatography: basics, use | Introduce students to the concept of high performance liquid chromatography | ЗН 1- 4,6,8,9 УМ 1,5,7- 9,10,11 | Holota S, PhD, Associate Professor |
| CPC-3 | Infrared spectroscopy, UV spectroscopy, atomic adsorption | To acquaint students with the concept of Infrared spectroscopy, UV spectroscopy, atomic adsorption spectrometry | ЗН 1- 4,6,8,9 УМ 1,5,7- | Holota S, PhD, Associate Professor |

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| | spectrometry | | 9,10,11 | |
| CPC-4 | Electronic paramagnetic resonance, principles, features, use | To acquaint students with the concept of electronic paramagnetic resonance | 3H 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| CPC-5 | Nuclear magnetic resonance spectroscopy, basics, principles of use | To acquaint students with the concept of nuclear magnetic resonance spectroscopy | 3H 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| CPC-6 | Mass spectrometry in search of new drugs and research medicines | To acquaint students with the concept of mass spectrometry. | 3H 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| CPC-7 | Combination of chromatographic and mass spectrometric methods | To acquaint students with the peculiarities of the combination of chromatographic and mass spectrometric methods in the analysis of drugs. | 3H 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| CPC-8 | Methods of spectroscopy in the near infrared region | To acquaint students with the methods of spectroscopy in the near infrared region | 3H 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| CPC-9 | Crystallographic methods | To acquaint students with crystallographic methods of drug analysis. | 3H 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |
| CPC-10 | Methods of thermal analysis and calorimetric methods of analysis | To acquaint students with methods of thermal analysis and calorimetric methods of analysis. | 3H 1-4,6,8,9 УМ 1,5,7-9,10,11 | Holota S, PhD, Associate Professor |

8. Verification of learning outcomes

Carried out in each lesson according to specific goals, as well as during the individual work of the teacher with the student for those topics that the student develops independently and they are not part of the structure of the practical lesson. A standardized form of control of theoretical and practical training of students is used.

The standardized form of control of the theoretical part includes 10 tasks. Five of them of the first level are test (1 point each), and five tasks of the second level, to which in addition to the test answer you need to give a written answer (2 points each).

Assessment of practical training of students - as a result of the practical part - is made in the form of a protocol.

At the end of each of the 4 content modules on which the discipline is structured, the student writes a final test, which includes 50 tests of A format (1 point) and 3 theoretical questions (10 points).

The final grade for the current educational activity is set on a 4-point (national) scale.

Criteria for evaluating current learning activities:

A grade of "5" (excellent) is given to a student who actively participated in the discussion of the most difficult questions on the topic of the lesson, gave at least 90% correct answers to standardized test tasks, answered written tasks without errors, did practical work and drew up a protocol.

Grade "4" (good) is given to the student who participated in the discussion of the most difficult questions on the topic, gave at least 75% correct answers to standardized test tasks, made some minor mistakes in answering written tasks, did practical work and drew up a protocol.

Grade "3" (satisfactory) is given to a student who did not participate in the discussion of the most

difficult questions on the topic, gave at least 60% correct answers to standardized test tasks, made significant mistakes in answering written tasks, did practical work and drew up a protocol.

Grade "2" (unsatisfactory) is given to a student who did not participate in the discussion of the most difficult questions on the topic, gave less than 60% of correct answers to standardized test tasks, made gross mistakes in answering written tasks or did not answer them at all. performed practical work and did not draw up a protocol.

| Learning outcome code | Code of the type of classes | Method of verification of learning outcomes | Enrollment criteria |
|---|-----------------------------|---|---|
| 3H-1 Y _M -1 K-2 | Π-1 | 1. Acquaintance with the organization and procedure of practical classes in organic chemistry. 2. Acquaintance with safety precautions and rules of work in a chemical laboratory. 3. Consideration of the basic principles of classification and nomenclature of organic compounds and types of structural isomerism. 4. Acquaintance with the equipment used in the chemical laboratory. 5. Performing training exercises and tests. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-2 3H-5 | Π-2 CPC-1 | 1. Control of home self-preparation. 2. Solving training exercises. 3. Control of knowledge of theoretical material. 4. Work with chemical utensils and laboratory equipment, assembly of equipment for various distillation methods, etc. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-5 Y _M -1 Y _M -2 Y _M -3 Y _M -4 K-2 | Π-3 CPC-2 | 1. Checking the preparation of students for classes. 2. Demonstration of methods for isolation and purification of organic compounds 3. Familiarity with the methods of establishing physical constants of organic compounds. 4. Performance by students of a practical part of the class. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-1 | Π-4 CPC-3 | 1. Control of homework. 2. Consideration on models, computer programs and tables of the spatial structure of organic compounds, conformations and configuration states of molecules and methods of their representation. 3. Solving training exercises and monitoring their implementation. 4. Practical part: - a compilation of models of chiral molecules of lactic and tartaric acids; - assembly of ethane, butane and ethylene glycol conformation models. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-3 3H-4 Y _M -1 Y _M -2 Y _M -5 Y _M -7 K-2 | Π-5 CPC-4 CPC-5 | 1. Control of home self-preparation. 2. Solving training exercises. Monitoring their implementation. 3. Performing of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 Y _M -6 | Π-6 | 1. Control of home self-preparation. 2. Solving training exercises. Monitoring their implementation. 3. Performing of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 | Π-7 | 1. Control of home self-preparation. | evaluation |

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| Y _M -6 Y _M -7 | CPC-6 | 2. Solving training exercises. Monitoring their implementation. 3. Performing of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | according to the established criteria on a traditional 4-point scale |
| 3 _H -4 Y _M -6 Y _M -7 | Π-8 CPC-7 | 1. Control of home self-preparation. 2. Solving training exercises. Monitoring their implementation. 3. Performing of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3 _H -4 Y _M -6 Y _M -7 | Π-9 CPC-8 | 1. Control of home self-preparation. 2. Solving training exercises. Monitoring their implementation. 3. Performing of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. 5. Writing the final test. | evaluation according to the established criteria on a traditional 4-point scale |
| 3 _H -4 3 _H -5 Y _M -1 Y _M -2 Y _M -3 Y _M -6 Y _M -7 Y _M -8 AB-1 | Π-10 CPC-9 | 1. Discussion of the main points of the topic. 2. Test control of knowledge. 3. Solving training exercises and monitoring their implementation. 4. Performing of experiments. 5. Verification of theoretical preparation of students for synthesis. 6. Performing of syntheses. 7. Control of mastering of theoretical material and practical part (performed experiments and syntheses) of the topic. | evaluation according to the established criteria on a traditional 4-point scale |
| 3 _H -4 3 _H -5 Y _M -1 Y _M -2 Y _M -3 Y _M -6 Y _M -7 Y _M -8 AB-1 | Π-11 CPC-14 | 1. Continuation of synthesis and calculation of product yield. 2. Homework control. 3. Solving training exercises and monitoring their implementation. 4. Execution of experiments. 5. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3 _H -4 Y _M -6 Y _M -7 | Π-12 CPC-10 | 1. Control of home self-preparation. 2. Solving training exercises. Monitoring their completion. 3. Execution of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3 _H -2 3 _H -4 Y _M -6 Y _M -7 | Π-13 CPC-11 CPC-13 CPC-15 | 1. Control of home self-preparation. 2. Solving training exercises. Monitoring their completion. 3. Execution of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3 _H -4 3 _H -5 Y _M -1 Y _M -2 Y _M -3 Y _M -6 Y _M -7 Y _M -8 | Π-14 | 1. Consideration of the main points of the topic. 2. Execution of training exercises and control of their completion. 3. Checking the synthesis plan and the correctness of the assembly of equipment. 4. Execution of experiments and syntheses. 5. Control of theoretical knowledge and acquired practical skills. | evaluation according to the established criteria on a traditional 4-point scale |

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| AB-1 | | | |
| 3H-4 3H-5 YM-1 YM-2 YM-3 YM-6 YM-7 YM-8 AB-1 | П-15 | <ol style="list-style-type: none"> 1. Completion of syntheses. 2. Discussion of the main points of the topic. 3. Test control of knowledge. 4. Solving training exercises. 5. Execution of experiments. 6. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 3H-5 YM-1 YM-2 YM-3 YM-6 YM-7 YM-8 AB-1 | П-16 CPC-12 | <ol style="list-style-type: none"> 1. Checking the theoretical preparation of students for synthesis. 2. Test control of knowledge. 3. Execution of syntheses (methyl orange, β-naphthol orange). 4. Control of synthetic work. 5. Writing the final test. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | П-17 CPC-16 | <ol style="list-style-type: none"> 1. Control of home self-preparation. 2. Solving training exercises. 3. Execution of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | П-18 CPC-17 | <ol style="list-style-type: none"> 1. Control performance of home self-training. 2. Solving of educational exercises. 3. Support of molecules models. 4. Performing of experiments. 5. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 3H-5 YM-1 YM-2 YM-3 YM-6 YM-7 YM-8 AB-1 | П-19 CPC-17 | <ol style="list-style-type: none"> 1. Control performance of home self-training. 2. Solving of educational exercises. 3. Support of molecules models. 4. Performing of experiments. 5. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 3H-5 YM-1 YM-2 YM-3 YM-6 YM-7 YM-8 AB-1 | П-20 | <ol style="list-style-type: none"> 1. Control of mastering the topic from theoretical material and from performed experiments. 2. Control performance of home self-training. 3. Solving of educational exercises. 4. Performing of experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | П-21 CPC-18 | <ol style="list-style-type: none"> 1. Control performance of home self-training. 2. Solving of educational exercises. 3. Performing of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | П-22 CPC-19 CPC-20 | <ol style="list-style-type: none"> 1. Control performance of home self-training. 2. Solving of educational exercises. 3. Performing of experiments. | evaluation according to the established |

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| | | 4. Control of mastering the topic from theoretical material and from performed experiments. | criteria on a traditional 4-point scale |
| 3H-4 3H-5 YM-1 YM-2 YM-3 YM-6 YM-7 YM-8 AB-1 | II-23 | 1. Control performance of home self-training. 2. Control of mastering the topic from theoretical material and from performed experiments. 3. Execution of syntheses and registration of protocols. 4. Writing of final control work. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | II-24 CPC-21 | 1. Control performance of home self-training. 2. Solving of educational exercises. 3. Support of molecules models. 4. Performing of experiments. 5. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | II-25 CPC-23 | 1. Control performance of home self-training. 2. Consideration of models, slides and structures of structure and reactivity of six-member heterocyclic compounds. 3. Solving of educational exercises. 4. Scoring models of molecules of six-membered heterocycles. 5. Performing of experiments. 6. Control assimilation of the topic theoretical material and the experiments performed. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | II-26 CPC-22 | 1. Control performance of home self-training. 2. Solving of educational exercises. 3. Support of molecules models. 4. Performing of experiments. 5. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | II-27 | 1. Control performance of home self-training. 2. Consideration of models, slides and structures of structure, reactivity and relationship between structure and pharmacological effects of monosaccharides derivatives. 3. Solving of educational exercises. 4. Performing of experiments. 5. Control assimilation of the topic theoretical material and the experiments performed. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | II-28 CPC-24 CPC-28 | 1. Control performance of home self-training. 2. Solving of educational exercises. 3. Performing of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | II-29 | 1. Control performance of home self-training. 2. Solving of educational exercises. 3. Performing of experiments. 4. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3H-4 YM-6 YM-7 | II-30 CPC-26 | 1. Control performance of home self-training. 2. The consideration of the schemes of the structure of nucleosides, nucleotides, nucleic acids. | evaluation according to the established |

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| | | 3. Solving of educational exercises. 4. Control of mastering the topic from theoretical material and from performed experiments. | criteria on a traditional 4-point scale |
| 3 _H -4 У _M -6 У _M -7 | II-31 CPC-27 | 1. Control performance of home self-training. 2. The consideration on the schemes of the issues of structure and reactions occurring in vivo and in vitro. 3. Solving of educational exercises. 4. Performing of experiments. 5. Control of mastering the topic from theoretical material and from performed experiments. | evaluation according to the established criteria on a traditional 4-point scale |
| 3 _H -4 У _M -6 У _M -7 AB-2 AB-3 | II-32 CPC-25 CPC-29 | 1. Control performance of home self-training. 2. Consideration of models, slides and structures of structure, reactivity and interconnection structure-pharmacological effects of derivatives of mentan, terpenes, carotenoids and steroids. (3. Solving of educational exercises. 4. Performing of experiments. 5. Control of mastering the topic from theoretical material and from performed experiments. 6. Writing a final control work. | evaluation according to the established criteria on a traditional 4-point scale |

Final control

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| General evaluation system | Participation in the work during the semester / exam - 60% / 40% on a 200-point scale |
| Rating scales | Traditional 4-point scale, multi-point (200-point) scale, ECTS rating scale |
| Conditions of admission to the final control | The student attended all practical (laboratory, seminar) classes and received at least 72 points for current performance |

| Type of final control | Methods of final control | Enrollment criteria |
|-----------------------|---|---|
| Exam | The exam is held during the examination session according to the schedule and includes: 50 tests (Form A), which are evaluated by 1 point (50 minutes), 6 "open" questions, which are evaluated by 5 points (40 minutes) | Enrollment of the test task of the I level: correct answer -1 point, incorrect answer - 0 points. The answer to the theoretical problem of the II level is estimated from 0 to 3 points: correct letter answer -1 point, incorrect letter answer - 0 points. The written task is evaluated from 0 to 2 points. The maximum number of points that a student can score when taking the exam is 80. The minimum number of points in the exam - not less than 50. |

The maximum number of points that a student can score for the current academic activity for admission to the exam is 120 points.

The minimum number of points that a student must score for the current academic activity for admission to the exam is 72 points.

The calculation of the number of points is based on the grades received by the student on a 4-point (national) scale during the study of the discipline, by calculating the arithmetic mean (CA), rounded to two decimal places. The resulting value is converted into points on a multi-point scale as follows:

$$x = \frac{CA \times 120}{5}$$

9. Course policy

The student must independently complete homework, training exercises and tests, tasks of current and final control. It is not allowed to spy on another student's work, write off, use a textbook, notebook or mobile phone while writing a test, final or exam paper, use cheat sheets, copy your work by other students.

Omissions of practical classes are not allowed. If a student misses classes for good reasons, which are documented, he has the right to practice them.

10. Literature

The main literature

1. J. Komarytsia. Organic Chemistry. Handbook for pharmaceutical students. Lviv 2000.-151 p.
2. B.S.Zimenkovsky, V.A. Muzychenko, I.V.Nizhenkovska, G.O.Syrova. Biological and bioorganic chemistry. Aus Medicine Publishing. Kyiv.2018. – 288 p.

The additional literature

1. Stoker, H.S. (2001). Organic and biological chemistry. Houghton Mifflin. 2001. 556p.
2. L.G. Wade Jr. Organic Chemistry. 8th edition. Pearson. 547p.
3. T. Graham Solomons. Organic Chemistry. Sixth edition. John Willey and Sons, Inc.- 1218 p.
4. Harold Hart, Leslie E. Crain, David J. Hart. Organic Chemistry. A Short Course. Houghton Mifflin Company. – 543 p.
5. David C. Eaton. Laboratory investigation in Organic Chemistry. – MCGRAW-HILL BOOK COMPANY. – New York – Toronto. – 893 p.

Information resources

1. www.ncbi.nlm.nih.gov/PubMed – free access to the database of scientific research in the field of biomedical sciences.
2. <https://pubchem.ncbi.nlm.nih.gov/> free access to the database of scientific data in the field of biomedical sciences.
3. <http://www.orgsyn.org> - has provided the chemistry community with detailed, reliable, and carefully checked procedures for the synthesis of organic compounds.
4. <http://www.organic-chemistry.org> - offers an overview of recent topics, interesting reactions, and information on important chemicals for organic chemists.
6. www.bioorganica.org.ua - a scientific publication that presents works on bioorganic and medical chemistry.

11. Equipment, logistics and software of the discipline

Equipment for laboratory work in the discipline, chemical utensils, reagents, multimedia projector for classes, overhead projector, computers, Internet for individual tasks, platform for distance learning MISA; thematic tables, molecule models, methodical instructions for practical and independent work are posted on the MISA distance learning service and are freely available to students.

12. Additional information

The department has a permanent student research group.

The Syllabus was developed by:
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