

Odessa National Medical University
Pharmaceutical faculty
Department of Pharmaceutical Chemistry

Syllabus of the course
Pharmaceutical chemistry

Amount	13 credits 390 hours
Semester, year of study	5, 6, 7, 8, 9 semesters 3, 4, 5 years of study
Days, time, place	Days, time and place are determined according to the approved schedule
Teachers	Gelmboldt Volodymyr Olegovych, Doctor of Chemistry, Professor Anisimov Volodymyr Yuriyovych, Ph.D., Associate Professor Osiychuk Olga Volodymyrivna, Ph.D., Associate Professor Nikitin Olexiy Volodymyrovych, the senior teacher Lytvynchuk Iryna Viktorivna, assistant Golubchik Khrystyna Olegivna, Ph.D., assistant Shishkin Ivan Olegovych, assistant
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Workplace	Department of Pharmaceutical Chemistry
Consultations	Consultations take place according to the approved schedule, both offline (face-to-face) and online, using ICT available to students and teachers

COMMUNICATION with students: E-mail, social networks, face-to-face meetings.

COURSE ANNOTATION

The subject of study of the discipline:

chemical structure of drugs, their physical and chemical properties; relationship between chemical structure and action on the body, methods of quality control and changes that occur during storage and metabolism, as well as methods of production and purification of drugs, biologically active compounds and their metabolites.

Prerequisites: to study the course students need basic knowledge of inorganic chemistry, analytical chemistry, organic chemistry, physical and colloid chemistry, physics with the basics of metrology, pharmacology, biological chemistry, normal physiology, pathological physiology, toxicological chemistry, pharmacognosy, drug technology, clinical pharmacy, drug standardization funds.

Postrequisites: lays the foundations for the study and completion by students of Industrial Practice in Pharmaceutical Chemistry, as well as for passing the state certification.

The purpose of the course: provide systematic knowledge on the structure of drugs, methods of their extraction, identification and quantification, physical, physicochemical and chemical properties, chemical factors of pharmacological action, patterns of relationship structure - biological / pharmacological activity and metabolic transformations, purity studies, application and storage, as well as approaches to the creation of new synthetic drugs and biologically active substances.

Tasks of discipline:

acquisition of skills in 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", avoiding possible interaction of drugs in their manufacture and use, establishing the quality of individual drugs, their multicomponent mixtures and ensuring their proper storage, acquiring knowledge of the basic methods of drug synthesis or extraction from natural raw materials; in the field of pharmaceutical analysis.

Expected results:

- know the chemical and pharmacological classification of drugs;
- know the international non-proprietary names of medicinal substances and drugs of which they are a part;
- know the basic laws of the relationship "structure-activity", approaches to adequate replacement of drugs;
- know the main ways of metabolism of drugs, the optimal conditions of action of prodrugs;
- know the most common dangers of chemical interaction of drugs with each other and with food, which can impair bioavailability, safety and efficacy;
- know the chemical basis of rational use of drugs;
- know the state regulation of the quality of medicines;
- know the methods of qualitative and quantitative analysis of drugs;
- know the qualitative analysis of cations and anions;
- know the elemental analysis and analysis by functional groups;
- know the functional analysis of organic compounds by functional groups;
- know chemical titrimetric methods of analysis;

- know the chromatographic methods of identification, gravimetric method of analysis;
- know the methods of purity research;
- know the methods of prevention and rapid detection of possible falsification of drugs;
- be able to determine the affiliation of the drug to the pharmacological group, taking into account the chemical structure, to make recommendations for possible replacement of the drug within the pharmacological group;
- be able to provide qualified pharmaceutical care to patients, taking into account the physical, physicochemical and chemical properties of drugs;
- be able to determine the possible interaction of drugs when used together and provide recommendations for its prevention;
- be able to provide information to the patient about possible adverse effects on the action of the food product;
- be able to determine the optimal conditions for storage of drugs;
- be able to provide recommendations to the pharmacist in the manufacture of drugs on possible chemical incompatibilities and ways to avoid it;
- be able to use analytical documentation that regulates the quality of medicines (State Pharmacopoeia, International Pharmacopoeia, national and regional pharmacopoeias, ICC, relevant orders and instructions);
- be able to use industry standards, guidelines for the implementation of methods of quality control of substances and drugs;
- be able to use chemical, physical, physico-chemical methods in quality control of medicines;
- be able to choose and perform express methods of qualitative and quantitative analysis of dosage forms of in-pharmacy manufacturing;
- be able to give a qualified assessment of the quality of medicines in accordance with the results of the analysis.

COURSE DESCRIPTION

Forms and methods of teaching

The course will be presented in the form of lectures (50 hours) and practical classes (200 hours), organization of independent work of students (140 hours).

The lectures use a multimedia presentation; in practical classes - teaching materials, situational tasks, individual tasks, laboratory equipment, to test the acquired knowledge and skills - test and calculation tasks, for independent work provided a list of necessary literature sources.

The content of the discipline

Topic 1. Subject and objectives of pharmaceutical chemistry. Drug quality assessment system.

Topic 2. Analysis of physicochemical properties of drugs. means as one of the elements of drug quality assessment.

Topic 3. The use of spectroscopic and chromatographic methods in the identification of drugs; features of use of standard samples of medicinal substances and standard spectra.

Topic 4. Identification of drugs of inorganic nature.

Topic 5. Identification of drugs of organic nature by functional groups (functional analysis).

Topic 6. Reasons for changes in the structure of the drug. Nature and nature of impurities, methods of their detection.

Topic 7. Methods of quantitative analysis of the content of drugs. Gravimetry.

Topic 8. Titrimetric methods of quantitative analysis of drugs. Determination of nitrogen in organic compounds.

Topic 9. Optical methods in quantitative analysis of drugs.

Topic 10. Chromatographic methods. Methods based on thermodynamic properties of substances. Combination of extraction, chromatographic and optical methods in the analysis of dosage forms.

Topic 11. Express analysis of drugs. Current trends in the development of pharmaceutical analysis.

Topic 12. Express analysis of monocomponent drugs.

Topic 13. Express analysis of multicomponent drugs.

Topic 14. Express analysis of drugs. Analysis of an unknown drug.

Topic 15. Principles of classification of drugs, their nomenclature. Structure-activity relationship in drug development and analysis. Stages of drug development.

Topic 16. The main pathways of drug metabolism. Chemical reactions that underlie metabolic transformations. Metabolic phases. Factors influencing metabolic processes. Prodrugs.

Topic 17. Non-steroidal anti-inflammatory drugs. Characteristics, classification, relationship between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 18. Narcotic analgesics and their analogues. Characteristics, classification, relationship between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 19. Hypnotics. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 20. Drugs for anesthesia. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 21. Psychotropic drugs. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 22. Anticonvulsants and antiepileptics. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 23. Remedies for parkinsonism. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 24. Vomiting and antiemetics. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 25. Antitussives. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 26. Nootropic drugs. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 27. Antihistamines. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 28. Drugs that affect the afferent nervous system. Agents that stimulate the receptors of afferent nerve fibers. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 29. Means that reduce the sensitivity of afferent nerve fibers. Means for local anesthesia. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 30. Drugs that affect the efferent nervous system. Agents acting on cholinergic processes. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 31. Means that act mainly on adrenergic processes. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 32. Cardiotonic drugs. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 33. Antiarrhythmic drugs. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 34. Means that improve blood supply to organs and tissues. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 35. Peripheral vasodilators. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 36. Calcium ion antagonists. Potassium channel activators. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 37. Drugs that affect the renin-angiotensin system. Characteristics, classification, the relationship between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 38. Antihypertensive and hypertensive drugs. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 39. Angioprotectors. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 40. Antioxidants. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 41. Hypolipidemic drugs. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 42. Diuretics. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 43. Drugs that affect platelet aggregation and blood clotting. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 44. Antibiotics of heterocyclic structure. B-lactamase inhibitors. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 45. Tetracycline antibiotics and macrolides. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 46. Aminoglycoside antibiotics, amphenicols, other groups of antibiotics. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 47. Sulfanilamides. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 48. Derivatives of naphthyridine and quinolonecarboxylic acids. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 49. Derivatives of 8-oxyquinoline, quinoxaline and nitrofurans. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 50. Anti-TB drugs. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 51. Drugs used to treat cancer (alkylating agents, antimetabolites, alkaloids, antibiotics, hormonal agents and their antagonists, other groups). Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 52. Examples of "target" (target) anticancer drugs (drugs of different chemical groups). Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 53. Antiviral drugs. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 54. Antimalarial drugs. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 55. Drugs for the treatment of protozoal infections. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 56. Anthelmintics. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 57. Antifungal drugs. Characteristics, classification, connection between structure and action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 58. Antipediculosis and acaricides. Characteristics, classification, methods of production, methods of analysis, application in medicine.

Topic 59. Antiseptics and disinfectants. Characteristics, classification, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 60. Drugs of thyroid hormones, antithyroid drugs. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 61. Drugs of pancreatic hormones, Characteristics, classification, the relationship between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 62. Steroid hormones. Corticosteroids. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 63. Androgens, anabolic steroids and their analogues. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 64. Progestogens, estrogens. Birth control. Estrogens of non-steroidal structure. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 65. Water-soluble vitamins. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 66. Fat-soluble vitamins. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 67. Drugs that affect the immune system (immunotropic drugs). Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 68. Anorexigenic drugs. Sorbents, antidotes and complexes. Antiulcer drugs. Remedies for alcoholism. Characteristics, classification, connection between structure and pharmacological action, mechanism of action, methods of production, methods of analysis, application in medicine.

Topic 69. X-ray contrast and other diagnostic tools. Characteristics, classification, mechanism of action, methods of production, methods of analysis, application in medicine.

List of recommended reading

1. Державна фармакопея України: в 3 т. / Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Харків: Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів». 2014. – Т.1. – 1128 с.; – Т.2. – 724 с.; – Т.1. – 732 с.
2. Фармацевтична хімія / П.О. Безуглий, В.А. Георгіянц, І.С. Гриценко, І.В. та ін.: за ред. П.О. Безуглого. – Вінниця: Нова книга, 2017. – 456 с.
3. Pharmaceutical chemistry. Lectures for English-speaking students: the study guide for students of higher schools / V.A. Georgiyants, P.O. Bezugly, G.O. Burian, A.I. Abu Sharkh, K.A. Taran; edited by V.A. Georgiyants, P.O. Bezugly. – Kharkiv: NUPh ; Original, 2013. – 576 p.
4. Медична хімія: навч. посіб. для студентів вищих навчальних закладів / І.С. Гриценко, С.Г. Таран, Л.О. Перехода та ін.; за заг ред. І.С. Гриценка. – Харків: НФаУ: Золоті сторінки, 2017. – 552с.
5. От субстанции к лекарству: Учеб. пособие / [Безуглый П. А., Болотов В. В., Гриценко И. С. и др.]; под ред. В. П. Черныха – Х.: Изд-во НФаУ: Золотые страницы, 2005. – 1244 с.
6. Туркевич М., Владзімірська О., Лесик Р. Фармацевтична хімія (стероїдні гормони, їх синтетичні замінники і гетероциклічні сполуки як лікарські засоби). Підручник. – Вінниця: Нова Книга, 2003. – 464 с.
7. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1128 с.
8. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 2. – 724 с.
9. Державна Фармакопея України : в 3 т. / ДП «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Х. : Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.

EVALUATION

During the study of the discipline various forms of lesson control are used (oral, written, combined, testing, practical skills, etc.). The results of students' academic performance are presented in the form of assessment on the national scale,

200-point and ECTS scale and have standardized generalized criteria for assessing knowledge.

Assessment of knowledge is on a national scale:

- a grade "excellent" is given to a student who systematically worked during the term, showed during the test versatile and deep knowledge of the program material, is able to successfully perform the tasks provided by the program, mastered the content of basic and additional literature, realized the relationship of individual sections of the discipline importance for the future profession, showed creative abilities in understanding and using educational material, showed the ability to independently update and replenish knowledge; level of competence - high (creative);

- a grade "good" is given to a student who has shown full knowledge of the curriculum, successfully completes the tasks provided by the program, mastered the basic literature recommended by the program, showed a sufficient level of knowledge in the discipline and is able to independently update and update during further study and professional activity; level of competence - sufficient (constructive-variable);

- a grade "satisfactory" is given to the student who has shown knowledge of the basic educational program material in the volume necessary for the further training and the subsequent work on a profession, copes with performance of the tasks provided by the program, has made separate mistakes in answers on examination and at performance of examination tasks, but has the necessary knowledge to overcome mistakes under the guidance of a researcher; level of competence - average (reproductive);

- a grade "unsatisfactory" is given to the student who did not show sufficient knowledge of the basic educational and program material, made fundamental mistakes in performance of the tasks provided by the program, cannot use the knowledge at the further training without the help of the lecturer/tutor, failed to master skills of independent work; the level of competence is low (receptive-productive).

The order of assessment of student's educational activity

Methods of current control: current control carried out at each practical lesson in accordance with the specific objectives of the topic. All practical classes use objective control over the performance of independent work, theoretical training and acquisition of practical skills. The following means of diagnosing the level of preparation of students are used: oral examination, testing, solving situational problems.

A form of final control knowledge of the discipline is an exam. The grade for the discipline is 50% of the current performance (arithmetic mean of all current student grades) and 50% - the grade on the exam.

To evaluate the discipline on a 4-point traditional (national) scale, the average score for the discipline is first calculated as the arithmetic mean of the two components:

1. the average current score as the arithmetic of all current scores (calculated as a number rounded to 2 (two) decimal places).
2. traditional exam grade.

Tickets for the exam consist of theoretical (2 questions) and practical questions (2 questions) in all sections studied in this discipline. Tasks include all the main sections

of the course, designed for written completion within 90 minutes. Designed to test knowledge, skills and abilities in solving specific problems. Examples of examination questions are given in the appendix to the work program

Conversion of a traditional grade from a discipline on a multi-point scale.

The multi-point scale characterizes the actual success of each student in mastering the discipline. Conversion of the traditional grade from the discipline to 200-point is performed by the information and computer center of the university program "Contingent" according to the formula:

Average score of success (current / discipline) x 40

national assessment	marks
«5»	185-200
«4»	151-184
«3»	120-150

The ECTS rating scale evaluates the achievements of students in the discipline who study in one course of one specialty, in accordance with the points obtained by them, by ranking, namely:

Scale ECTS	Statistical index
«A»	The best 10 % of students
«B»	Next 25 % of students
«C»	Next 30 % of students
«D»	Next 25 % of students
«E»	The last 10% of students

The ECTS scale establishes the student's belonging to the group of the best or worst among the reference group of classmates (faculty, specialty), ie his rating. When converting from a multi-point scale, as a rule, the limits of grades "A", "B", "C", "D", "E" do not coincide with the limits of grades "5", "4", "3" on the traditional scale. A grade of "A" on the ECTS scale cannot be equal to a grade of "excellent", and a grade of "B" - a grade of "good" and so on.

Students who have received grades "Fx" and "F" ("2") are not included in the list of ranked students. Such students automatically receive a score of "E" after re-assembly.

The grade "Fx" is given to students who have scored the minimum number of points for the current educational activity, but who do not pass the final control. Grade "F" is given to students who have attended all classes in the discipline, but did not score an average score (3.00) for current academic activities and are not admitted to the final control.

COURSE POLICY

Deadline and recompilation policy

Students who have completed all types of work provided for in the initial program, completed all training sessions and scored at least the minimum number of points while studying the module are admitted to the final control.

The practice of missed practical classes, regardless of the reason for the absence, and consultations take place in accordance with the departmental schedule of rehearsals and consultations. The practice of missed practical classes is carried out with an entry in the journal of the department's work and a mark on the permit form from the dean's office. Skipping a lecture without a good reason is completed by the student through an interview with the lecturer, or a presentation of the missed topic. Rearrangement of the current and final modules in order to increase the assessment is not allowed, except for situations provided by the "Regulations on the diploma of the state standard with honors".

Policy of Academic Integrity

Adherence to academic integrity by students provides:

- ♦ independent performance of educational tasks, tasks of current and final control of learning outcomes (for persons with special educational needs this requirement is applied taking into account their individual needs and opportunities);
- ♦ links to sources of information in the case of the use of ideas, developments, statements, information;
- ♦ compliance with the law on copyright and related rights;
- ♦ providing reliable information about the results of their own (scientific, creative) activities, used research methods and sources of information.

They are unacceptable in educational activities for participants in the educational process:

- the use of family or business ties to obtain a positive or higher assessment in the implementation of any form of control of learning outcomes or advantages in scientific work;
- use of prohibited auxiliary materials or technical means during checks (cheat sheets, abstracts, headphones, telephones, smartphones, tablets, etc.);
- passing the procedures of control of learning outcomes by fictitious persons.

For violation of academic integrity, students may be held liable for such academic liability:

- reduction of results of assessment of control work, examination, credit, etc.;
- re-assessment (test, exam, test, etc.);
- appointment of additional control measures (additional individual tasks, tests, tests, etc.);
- re-passing the relevant educational component of the educational program;
- conducting additional verification of other works by the infringer;
- deprivation of the right to participate in competitions for scholarships, grants, etc.;
- notification of the entity that finances the training (research), the institution that issued the grant for training (research), potential employers, parents of the applicant for higher education about the violation;
- exclusion from the rating of applicants for an academic scholarship or accrual of penalty points in such a rating;

- deprivation of an academic scholarship;
- deprivation of tuition benefits provided by the University;
- expulsions from the University.

Attendance and lateness policy: attendance at all classes: lectures, practical classes, current and final control is mandatory (exception: good reason). Delay of more than 5 minutes without good reason is not allowed. Within two days, in any form convenient for the student, inform the dean's office about the reasons that make it impossible to attend classes and perform other tasks provided by the curriculum.

Mobile devices: it is forbidden to write off during the control of knowledge (including the use of mobile technical means of information transfer).

Behavior in the audience:

- attend lectures, laboratory classes according to the schedule in medical gowns;
- do not be late for class;
- do not talk during classes;
- turn off your mobile phone.