Odessa National Medical University
Faculty of Pharmacy
Department of Pharmaceutical Chemistry

Syllabus course
Analytical chemistry

Amount	8 credits 240 hours
Semester, year of study	3, 4 semesters 2 years of study
Days, time, place	Days, time and place are determined according to the approved schedule
Teachers	Nikitin Alexey Vladimirovich, the senior teacher Lytvynchuk Iryna Viktorivna, assistant Golubchik Khrystyna Olehivna, Ph.D., assistant
Contact phone	(048) 7779828
E-mail	Nikitin O.V. nikitinalex35@gmail.com Lytvynchuk I.V. lytvynchuk_iryna@ukr.net Golubchik K.O. golubchikko@gmail.com
Workplace	Department of Pharmaceutical Chemistry
Consultations	Consultations take place according to the approved schedule, both offline (face-to-face) and offline online, using ICT available to students and teachers

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

COURSE ANNOTATION

Subject of study of the discipline -the relationship of the analytical properties of elements and their compounds with the position in the periodic table D.I. Mendeleev, as well as the principles of qualitative and quantitative analysis of inorganic and organic substances.

*Prerequisites:*knowledge of chemistry, physics, mathematics.

*Postrequisites:*acquisition of knowledge in analytical chemistry and their application for further study of the cycle of pharmaceutical disciplines, and will be widely used in the practical work of the specialist.

Course purpose: preparation of students for the development of special disciplines, for which on the basis of modern scientific ideas forms in students the necessary knowledge, skills and abilities in the field of analytical chemistry.

Tasks of the discipline:

- to form students' knowledge of the theoretical foundations of qualitative and quantitative methods of analysis;

- to ensure that students master the technique of performing basic analytical operations;
- to teach students to work with the main types of equipment used in chemical and pharmaceutical analysis;
- teach students to apply the acquired knowledge for the analysis of drugs and chemicals;
- learn to evaluate the results of an analytical experiment using mathematical processing;
- to form chemical-analytical thinking in order to use the most rational method of analysis to solve a specific analytical problem, develop a research plan and perform an experiment.
-acquisition by students of practical competencies in the field of professional activity of pharmaceutical workers

Expected results:

As a result of studying the discipline, students should know:

– basic concepts and laws underlying analytical chemistry;
– main stages of development of analytical chemistry, its current state;
– methods and ways of performing qualitative analysis;
– methods, techniques and methods of performing chemical and physico-chemical analysis to establish qualitative composition and quantitative definitions;
– methods for detecting cations and anions;
– basics of mathematical statistics for assessing the accuracy and reproducibility of the results of quantitative analysis;
– safety rules when working in a chemical laboratory;
– the role and importance of methods of analytical chemistry in pharmacy, in the practical activities of the pharmacist;

Students must be able to

–use measuring utensils, analytical scales; have the technique to perform basic analytical operations in qualitative and quantitative analysis of the substance, to prepare and standardize solutions of analytical reagents;
–to take an average sample, to make the scheme of the analysis, to carry out the qualitative and quantitative analysis of substance;
–work with the main types of instruments used in the analysis; choose the optimal method of qualitative and quantitative analysis of the substance;
–to conduct laboratory experiments, to explain the essence of specific reactions and their analytical effects, to draw up reporting documentation based on experimental data;
–perform initial calculations, final calculations using statistical processing of the results of quantitative analysis;
–work independently with educational and reference literature on analytical chemistry.

COURSE DESCRIPTION

Forms and methods of teaching

The course will be presented in the form of lectures (30 hours) and practical classes (120 hours), organization of independent work of students (90 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. Introduction to qualitative analysis.
Topic 2. Qualitative reactions for determination of cations of analytical group I.
Topic 3. Theory of strong electrolytes.
Topic 4. Heterogeneous equilibria.
Topic 5. Qualitative reactions for determination of cations of II and III analytical groups.
Topic 6. Systematic course of analysis of a mixture of cations of I-III analytical groups according to acid-base classification.
Topic 7. Acid-base equilibria in analytical chemistry.
Topic 8. Qualitative reactions for the determination of cations of analytical group IV.
Topic 9. Equilibria in complexation reactions.
Topic 10. Qualitative reactions for the determination of cations of V and VI analytical groups.
Topic 11. Systematic course of analysis of a mixture of cations of IV-VI analytical groups according to acid-base classification.
Topic 12. Systematic course of analysis of a mixture of cations of I-VI analytical groups according to acid-base classification.
Topic 13.Redox balances in analytical chemistry.
Topic 14. General characteristics of anions and analytical classifications of anions by groups. Qualitative reactions for determination of anions of the I analytical group and conditions of their performance.
Topic 15.Qualitative reactions for determination of anions of II and III analytical groups and conditions of their performance.
Topic 16. Analysis of a mixture of anions of groups I-III.
Topic 17. Methods of separation and concentration of substances in analytical chemistry.
Topic 18. Introduction to quantitative analysis. Weighing technique.
Topic 19. Gravimetric analysis. Application of gravimetry for drug analysis.
Topic 20. Titrimetric methods of analysis. Calculations in titrimetric analysis.
Topic 21. Acid-base titration. Titration of strong acids with strong bases and vice versa.
Topic 22. Acid-base titration. Titration of weak acids with alkalis and weak bases with strong acids.
Topic 23. Acid-base titration. Titration of polybasic acids, multiacid bases, mixtures of acids or bases.
Topic 24. Acid-base titration. Titration of ampholytes. Statistical processing of analysis results.
Topic 25. General provisions of redox titration.
Topic 26. Redox titration. Permanganatometry.
Topic 27. Redox titration. Iodimetry, iodometry.

Topic 28.Redox titration. Dichromatometry.
Topic 29. Redox titration. Bromatometry.
Topic 30.Redox titration. Nitritometry.
Topic 31.Terms precipitating titration.
Topic 32. Sedimentation titration. Argentometry. Mercurometry.
Topic 33. Complexim etric titration. Complexometry.
Topic 34. Optical methods of analysis. Photocolorimetry and spectrophotometry. Electrochemical methods of analysis.

List of recommended reading

1. Analytical chemistry /Part I / Qualitative analysis:Educational manual for foreing students of the pharmaceutical higher school and pharmaceutical faculties of the III-IV level of «Quantitative analysis» accreditation / T.I. Yuschenko, N.I. Kaminska, A.E. Kosareva, L.V. Slobodyanik, O.P. Yaschuk; - Vinnitsya ,2012. – 160 p.
2. Аналитическая химия: учеб. пособие для студентов вузов / И.С. Гриценко, В. В. Болотов, С. В. Колесник [и др.]; под общ. ред. И.С. Гриценко. – 3-е изд., перерад. и доп. – Х.: НФаУ; Оригинал, 2017. – 504 с.
3. Аналитическая химия в схемах и таблицах: учеб. пособие для студ. учереждений высш. образования / И.С. Гриценко, В. В. Болотов, Л. Ю. Клименко и др.; под общ. ред. И.С. Гриценко. – 2-е изд., перераб. и доп. – Харьков: НФаУ: Золотые страницы, 2019. – 320 с.
4. Аналітична хімія: навч. посіб. для фармац. вузів та ф-тів III-IV рівня акредитації / В. В. Болотов, О. М. Свєчнікова, С. В. Колісник, Т. В. Жукова та ін. – Х.: Вид-во НФаУ; Оригінал, 2004. – 480 с.
5. Кількісний аналіз. Титриметричні методи аналізу / Петренко В.В., Стрілець Л.М., Васюк С.О. та ін. –Запоріжжя, 2006. – 215 с.
6. Конспект лекций по аналитической химии (Качественный анализ) / В. В. Болотов, Е. В. Дынник, Т. В. Жукова, Е. Г. Кизим, С. В. Колесник, Т. А. Костина, Е. Е. Микитенко, И. Ю. Петухова, Ю. В. Сыч. – Харьков: НФАУ; Золотые Страницы, 2002. – 164 с.
7. Конспект лекций по аналитической химии. Количественный Анализ: Учеб. пособие для студентов вузов / В. В. Болотов, Е. Н. Свечникова, Т. А. Костина, Н. Ю. Голик, Е. В. Дынник, Т. В. Жукова, М. А. Зареченский, Е. Г. Кизим, С. В. Колесник, Е. Е. Микитенко, В. П. Мороз, И. Ю. Петухова, Ю. В. Сыч; Под ред. проф. В. В. Болотова. – Харьков: НФаУ; Оригинал, 2005. – 200 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 controlcarried 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 during the module are admitted to the final control.

Rehearsals of missed practical classes, regardless of the reason for admission, and consultations take place in accordance with the departmental schedule of rehearsals and consultations. Practice of missed practical classes is carried out with an entry in the journal of the department 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"

Academic Integrity Policy

Observance of academic integrity by students of education 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 legislation on copyright and related rights;
- providing reliable information about the results of their own (scientific, creative) activities, used research methods and sources of information.

Unacceptable in educational activities for participants in the educational process are:

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

For violation of academic integrity, students may be held subject to the following 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, control works, 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;
- deductions 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).
Audience behavior:
- attend lectures, laboratory classes according to the schedule in bathrobes;
- do not be late for class;
- do not talk during classes;
- turn off your mobile phone,