SYLLABUS OF THE ACADEMIC DISCIPLINE "CHEMISTRY"

Academic degree	**Bachelor**
Academic program	**192 Building and Civil Engineering**
Duration	2-4 quarters
Classes:	2020 - 2021 years of study
Language	English
Department	Chemistry Dep.

Course page in SDO NTU "DP": https://do.nmu.org.ua/course/view.php?id=2165

Information about lecturers:

Assoc. prof. Olena Svietkina (Lectures)	Head of Department chemistry, candidate of chemistry sciences, doctor of technical sciences ("Chemistry technologies and engineering"), associate professor
As. Hanna Tarasova (Practical training)	Assistant of the Department of Chemistry
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1. Course abstract

Chemistry studies such form of substance motion which assumes qualitative change of matters i.e. transformation of one compounds into another. During chemical processes there is exchange of atoms between different matters, re-distribution of electrons between atoms, decay of one compounds and formation of new ones. As a result of chemical processes there happens formation of other substances with new chemical and physical qualities. To understand them it is necessary to know the composition of substances and laws of their transformation.

The main task of this course is to form in students a set of chemical knowledge about matter, its structure, transformation, possible areas of use; development of chemical thinking skills and the ability to use the achievements of fundamental disciplines in future professional activities.

The general theoretical basis of the course consists of the basic concepts and laws of chemistry, electronic structure of the atom, the nature of chemical bonding, thermodynamic and kinetic laws of chemical processes, the theory of solutions of non-electrolytes and electrolytes, chemical current sources, properties of metals, elements and their compounds.

The course presents material on the nature, classification and characteristics of different types of materials, their chemical and physical properties and different areas of use in modern construction and use in civil engineering. The main physicochemical factors of action on materials that shape the conditions of their operation are considered.

2. The purpose and objectives of the discipline

The purpose of the discipline is to develop students' logical thinking, emphasizing the importance of chemical knowledge in the creation and use of building materials, operation of machines and mechanisms, the creation of new environmentally friendly technologies, work in compliance with safety rules, the formation of future professionals (specialists) ideas about the systems of operation of installations and systems.

The study of this discipline will provide a holistic view of the subject of chemistry and its role in industry; get an idea of the laws of chemistry, the structure of the atom, chemical bonds, the basic laws of chemical processes; learn to understand the nature of chemical transformations; to gain practical knowledge during the performance of laboratory works, which can be used to assess the feasibility of production, fuel and energy systems of the country.

Course objectives:

– to teach higher education students to apply the basic concepts and laws of chemistry, patterns of chemical reactions, general information about chemical elements and their compounds in solving specific problems in accordance with modern needs;

– to acquaint higher education seekers with the development of the science of physical and chemistry of building materials as an independent fundamental branch of knowledge; with the nature and characteristics, chemical and physical bases of industrial use;

– use modern building materials, products and structures in the design and construction of construction projects, depending on the technology of their manufacture and technical characteristics;

– learn to determine the criteria for assessing chemical and environmental safety, taking into account the concentrations of relevant substances and solutions, the kinetics of processes, etc .;

– to teach applicants for higher education to conduct laboratory work and analyze research results, as well as the choice of more technological in terms of physico-chemical characteristics of the types of materials;

– consider different classes of construction materials according to chemical criteria, their origin, chemical composition, technological parameters, as well as structural features;

– formation of theoretical and practical ideas for the organization and conduct of laboratory chemical experiment

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3. Learning outcomes:

– Ability to operate with professional terms and concepts and to recognize the physical and chemical basis of phenomena and processes, applying knowledge and understanding of the subject area and professional orientation.

– Mastering the necessary practical skills to work independently, the ability to get results in a certain period of time with an emphasis on professional integrity and the prevention of plagiarism.

4. The structure of the discipline

LECTURES

Topic 1. Basic concepts and laws of chemistry. Structure of atoms and chemical bond.

Laws of conservation of mass, constancy of composition, multiple relations, equivalents, Avogadro, gas laws. Use of stoichiometric laws to calculate chemical processes. The concept of a modern system of relative atomic masses of elements, molecular masses, molar mass equivalent, mole. Quantum nature of radiation and energy absorption. The charge of atomic nuclei. Quantum numbers. Electronic formulas. Periodic law D. I. Mendeleev.

Topic 2. Regularities of chemical processes. Chemical kinetics. Chemical equilibrium

Solid, liquid, gaseous state of substances. Types of crystal lattices. Conductors, dielectrics, semiconductors. Laws of thermochemistry. Entropy, enthalpy, Gibbs

energy. Chemical kinetics. The rate of chemical reactions. The law of action of the masses. Vant-Goff's rule. Catalysis. Chemical equilibrium. Reversible and irreversible processes. Equilibrium equation, chemical equilibrium constant. The principle of Le Chatelier

Topic 3. Disperse systems. Solutions.

Homogeneous and heterogeneous dispersed systems. Methods of expressing the concentration of solutions. Solutions of non-electrolytes. Raoul's laws. Vant-Goff's law. Electrolyte solutions.

Topic 4. Theory of electrolytic dissociation. Ionic product of water. Hydrogen value. Solid hydrolysis.

Theory of electrolytic dissociation. The degree and constant of dissociation. Oswald's breeding law. Ionic product of water. Hydrogen value. Waterproof indicator. Solid hydrolysis.

Topic 5. Redox processes.

The degree of oxidation. Classification of redox reactions. Typical oxidants and reducing agents. Methods of compiling equations. Redox processes in electrochemical processes.

Topic 6. Galvanic cells.

Galvanic cells. Potentials of metals. Standard electrode potential. Hydrogen electrode. A number of metal stresses. The concept of galvanic cells, the use of EMF of a galvanic cell, the Nernst equation.

Topic 7. Electrolysis. Batteries.

Electrolysis of solutions and melts of electrolytes. Soluble and insoluble anodes. Decomposition voltage. Current output. Faraday's laws of electrolysis. Electrolysis in production. Electroplating, electroplating. Chemical power sources. Galvanic fuel cells. Batteries.

Topic 8. Corrosion of metals and measures to protect against corrosion.

Chemical and electrochemical corrosion of metals. Factors of electrochemical action. Anti-corrosion agents. Metal and non-metallic protective coatings, tread and cathodic protection.

Topic 9. General ideas about inorganic binders.

Inorganic binders. Concrete. Building solutions. Classification of solid binders: air and hydraulic.

Topic 10. Physico-chemical properties of inorganic binders.

Dispersibility, ductility and curability of inorganic binders. Colloidal solutions and gels. Inorganic binders: gypsum binders, Portland cement, corrosion of concrete and methods of its control, alumina cement, lime.

Topic 11. Introduction to organic chemistry.

Classification. Nomenclature. Surfactants.

LABORATORY WORK

LW-1 – Instruction on safety rules in the chemical laboratory. Determination of molar mass of metal equivalent;

LW 2 – Chemical kinetics;

LW-3– concentration;

LW 4 – Ionic reaction;

LW 5 – Solid Hydrolysis;

LW 6 - Redox;

LW 7 - Galvanic processes (problem solving);
LW 8 - Electrolysis as an electrochemical factor of action;
LW 9 - Different variants of electrolysis processes. Problem solving;
LW 10 - Corrosion of metals and protection against it.

5. The technical equipment and / or software

№ works (code)	Title	Tools, equipment and software used in the work
F17 LW-1	Instruction on safety rules in the chemical laboratory. Determination of molar mass of metal equivalent	Safety instruction The metal sample is a sample of zinc Hydrochloric acid solution Distilled water Thermometer, barometer
LW-2	Ionic reactions (chemical factor of action)	Electrolyte solutions Test tubes
LW-3	Hydrolysis of salts	Salt solutions Indicators Test tubes
LW-4	Redox	Test tubes Distilled water Set of reagents (solutions)
LW-5	Galvanic processes (problem solving)	Device for the study of the galvanic cell Tables, diagrams
LW-6	Electrolysis as an electrochemical factor of action	Device for studying the process of electrolysis Solutions of salts, indicators
LW-7	Different variants of electrolysis processes (problem solving)	Device for studying the process of electrolysis Tables, diagrams
LW-8	Corrosion of metals and protection against it	Chemical beaker, pipettes Galvanized and tinned iron plates Zinc granule, copper dart Set of reagents (solutions)

6 Knowledge progress testing

Certification of student achievement is accomplished through transparent procedures based on objective criteria in accordance with the University Regulations “On Evaluation of Higher Education Applicants' Learning Outcomes”.

The level of competencies achieved in relation to the expectations, identified during the control activities, reflects the real result of the student's study of the discipline.

6.1 Grading scales

Assessment of academic achievement of students of the Dnipro University of Technology is carried out based on a rating (100-point) and institutional grading scales. The latter is necessary (in the official absence of a national scale) to convert (transfer) grades for mobile students.

The scales of assessment of learning outcomes of the NTUDP students

Rating	Institutional
90 ... 100	Excellent
74 ... 89	Good
60 ... 73	Satisfactory
0 ... 59	Failed

Discipline credits are scored if the student has a final grade of at least 60 points. A lower grade is considered to be an academic debt that is subject to liquidation in accordance with the Regulations on the Organization of the Educational Process of NTUDP.

6.2 Diagnostic tools and evaluation procedures

The content of diagnostic tools is aimed at controlling the level of knowledge, skills, communication, autonomy, and responsibility of the student according to the requirements of the National Qualifications Framework (NQF) up to the 7th qualification level during the demonstration of the learning outcomes regulated by the work program.

During the control activities, the student should perform tasks focused solely on the demonstration of disciplinary learning outcomes (Section 2).

Diagnostic tools provided to students at the control activities in the form of tasks for the intermediate and final knowledge progress testing are formed by specifying the initial data and a way of demonstrating disciplinary learning outcomes.

Diagnostic tools (control tasks) for the intermediate and final knowledge progress testing are approved by the appropriate department.

Type of diagnostic tools and procedures for evaluating the intermediate and final knowledge progress testing are given below.

Diagnostic and assessment procedures

<table>
<tr><td colspan="3">INTERMEDIATE CONTROL</td><td colspan="2">FINAL ASSESSMENT</td></tr>
<tr><td>training sessions</td><td>diagnostic tools</td><td>procedures</td><td>diagnostic tools</td><td>procedures</td></tr>
<tr><td>lectures</td><td>control tasks for each topic</td><td>task during lectures</td><td rowspan="3">comprehensive reference work (CCW)</td><td rowspan="3">determining the average results of intermediate controls;

CCW performance during the examination at the request of the student</td></tr>
<tr><td rowspan="2">practical</td><td>control tasks for each topic</td><td>tasks during practical classes</td></tr>
<tr><td>or individual task</td><td>tasks during independent work</td></tr>
</table>

During the intermediate control, the lectures are evaluated by determining the quality of the performance of the control specific tasks. Practical classes are assessed by the quality of the control or individual task.

If the content of a particular type of teaching activity is subordinated to several descriptors, then the integral value of the assessment may be determined by the weighting coefficients set by the lecturer.

Provided that the level of results of the intermediate controls of all types of training at least 60 points, the final control can be carried out without the student's immediate participation by determining the weighted average value of the obtained grades.

Regardless of the results of the intermediate control, every student during the final knowledge progress testing has the right to perform the CDF, which contains tasks covering key disciplinary learning outcomes.

The number of specific tasks of the CDF should be consistent with the allotted time for completion. The number of CDF options should ensure that the task is individualized.

The value of the mark for the implementation of the CDF is determined by the average evaluation of the components (specific tasks) and is final.

The integral value of the CDF performance assessment can be determined by taking into account the weighting factors established by the department for each NLC descriptor.

6.3 Evaluation criteria

The actual student learning outcomes are identified and measured against what is expected during the control activities using criteria that describe the student's actions to demonstrate the achievement of the learning outcomes.

To evaluate the performance of the control tasks during the intermediate control of lectures and practicals the assimilation factor is used as a criterion, which automatically adapts the indicator to the rating scale:

$$O_i = 100\ a / m,$$

where a - number of correct answers or significant operations performed according to the solution standard; m - the total number of questions or substantial operations of the standard.

Individual tasks and complex control works are expertly evaluated using criteria that characterize the ratio of competency requirements and evaluation indicators to a rating scale.

7. Course policy

7.1. Academic Integrity Policy.

Academic integrity of students is an important condition for mastering the results of training in the discipline and obtaining a satisfactory grade on the current and final tests. Academic integrity is based on condemnation of the practices of copying (writing with external sources other than those allowed for use), plagiarism (reproduction of published texts by other authors without

indication of authorship), fabrication (fabrication of data or facts used in the educational process). The policy on academic integrity is regulated by the Regulation "Regulations on the system of prevention and detection of plagiarism at the Dnipro University of Technology
(http://www.nmu.org.ua/ua/content/activity/us_documents/
System_of_prevention_and_detection_of_plagiarism.pdf.)
In case of violation of academic integrity by a student (copying, plagiarism, fabrication), the work is evaluated unsatisfactorily and must be repeated. The teacher reserves the right to change the topic of the task.

7.2. Communication policy.

Students must have activated university mail.

It is the student's responsibility to check the mailbox at Office365 once a week (every Sunday).

During the weeks of independent work it is the student's responsibility to work with the distance course "Higher Mathematics" (www.do.nmu.org.ua)

All written questions to teachers regarding the course should be sent to the university e-mail.

7.3. Reassembly policy.

Works that are submitted in violation of deadlines without good reason are evaluated at a lower grade. Relocation takes place with the permission of the dean's office if there are good reasons (for example, sick leave).

7.4. Attending classes.

Full-time students are required to attend classes. Good reasons for not attending classes are illness, participation in university events, business trips, which must be confirmed by documents in case of prolonged (two weeks) absence. The student must inform the teacher either in person or through the headmaster about the absence from class and the reasons for absence. If a student is ill, we recommend staying home and studying with a distance platform. Students whose health is unsatisfactory and may affect the health of other students will be encouraged to leave the class (such absence will be considered an absence due to illness). Practical classes are not repeated, these assessments cannot be obtained during the consultation. For objective reasons (for example, international mobility), learning can take place remotely - online, in agreement with the teacher.

7.5 Evaluation Appeal Policy.

If the student does not agree with the assessment of his knowledge, he may appeal the assessment made by the teacher in the prescribed manner.

7.6. Bonuses.

Students who regularly attended lectures (have no more than two passes without good reason) and have a written syllabus of lectures receive an additional 2 points to the results of the assessment to the final grade.

7.7. Participation in the survey.

At the end of the course and before the session, students will be asked to fill out anonymously questionnaires (Microsoft Forms Office 365), which will be sent to your university mailboxes. Completing the questionnaires is an important component of your learning activity, which will allow you to assess the effectiveness of the teaching methods used and take into account your suggestions for improving the content of the discipline "Higher Mathematics".

8. Information resources

1) O.Y Svietkina Methodical instructions and tasks for self-work on the discipline of chemistry for students of all specialties (part 1) / O.Y Svietkina O.B. Netyaga, G.V. Tarasova Ministry of eduk. and sien of Ukrain, Nation. min. univer. – D .:, NMU, 2018. –21 p.

2) O.Y Svietkina Methodical instructions and tasks for self-work on the discipline of chemistry for students of all specialties (part 2) / O.Y Svietkina O.B. Netyaga, G.V. Tarasova Ministry of eduk. and sien of Ukrain, Nation. min. univer. – D :, NMU, 2018. –17 p.

3) O.Y Svietkina Methodical instructions "Laboratory work on chemistry" on the discipline of chemistry for students of all specialties/ O.Y Svietkina O.B. Netyaga, G.V. Tarasova Ministry of eduk. and sien of Ukrain, Nation. min. univer. – D.:, NMU, 2016. –20 p.

4) Svietkina O. Y. Basic concepts and laws of chemistry. Guidelines and objectives for self-study courses for students in all specialties / O. Y. Svietkina, O.B. Netyaga, G.V. Tarasova; Ministry of eduk. and sien. of Ukraine, Nation. min. univer. – D .: NMU, 2016. –20 p.

5) Chang R. GENERAL CHEMISTRY. The Essential Concepts./ /FIFTH EDITION: Published by McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. Copyright © 2008 by The McGraw-Hill Companies, Inc.– 836 p. ISBN 978–0–07–304851–2 MHID 0–07–304851–8 ISBN 978–0–07–304857–4 (Annotated Instructor's Edition) MHID 0–07–304857–7
https://www.rachidscience.com/2020/08/book-general-chemistry-5th-edition-by.html

Internet resource:

http://chemistry-chemists.com
http://himik.nmu.org.ua/ua/
http://fit.nmu.org.ua/ua/
http://trrkk.nmu.org.ua/ua/