



Approved by:

Dean

Date.....

SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI"

Faculty:.....Chemistry and Pharmacy.....

Subject area: (code and name)

C	H	L	3	8	2	4	1	3
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.....Pharmacy.....

M.Sc. Program: (code and name)

C	H	L	3	8	2	4	1	3
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.....Pharmacy.....

SYLLABUS

Course:

C	0	8	5
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General and Inorganic Chemistry 2

(code and name)

Lecturer: Assoc. Prof. Maria Milanova

Teaching assistant:

Academic work	Type	Acad. hours
In-class work	Lectures	30
	Seminars	0
	Practical classes (teaching assistance)	30
Total in-class work		60
Out-of-class work	Independent literature research	65
Total out-of-class work		65
TOTAL ACADEMIC WORK		125
ECTS credits in-class work		2.4
ECTS credits out-of-class work		2.6
TOTAL ECTS CREDITS		5

Nº	Grade components ¹	% of the score
1.	Mid-term test	20
2.	Final exam	80

¹ Depending on the course specificity and on the requirements of the teacher, other types of activity can be added or the unnecessary ones can be removed.

Outline of the course:

The course aims to introduce students to the most important properties of the elements and properties of their compounds, which are considered in relation to their position in the periodic table and on the basis of general principles, concepts and theories. Attention is paid to the processes and substances that have an important role in biological systems.

Practical exercises illustrate lectures, designed to create skills for its application in practice and to develop basic skills and handiness for laboratory work.

The program was adopted by the Faculty Board of the Faculty of Chemistry and Pharmacy

Preliminary requirements:

Course on General Chemistry to be attended.

Key competences acquired:

Knowledge on the important properties of the elements and properties of their compounds

Basic skills for laboratory work

Lessons plan

№	Topic: General and Inorganic Chemistry 2 (Chemistry of properties of the elements)	Acad. hours
	Lectures	
1	I. Hydrogen. Occurrence. Properties of the element. Ionic and covalent hydrides.	1
2	II. s- AND p- ELEMENTS. II.1. GROUP 1A. <i>General characteristics. Lithium, sodium, potassium.</i> Occurrence. Properties of the elements. Compounds. Biological activity, applications.	1
3	II.2. GROUP 2A. <i>General characteristics. Magnesium, calcium.</i> Occurrence. Properties of the elements. Compounds. Biological activity. Water hardness. Chemistry of photosynthesis	1
4.	II.3. GROUP 3A II.3.1. <i>General characteristics. Boron.</i> Properties of the element. Compounds. Boric acid. II.3.2. <i>Aluminium.</i> Distribution. Properties of the element. Compounds. Double salts (alum). II.3.3. <i>Gallium, indium, thallium.</i> Distribution. Characteristics of the compounds of Tl (I), toxicity.	2
5.	II.4. GROUP 4A II.4.1. <i>General characteristics. Carbon.</i> Distribution. Properties of the element. Compounds. Carbonic acid (equilibrium in the system $\text{CO}_2 - \text{H}_2\text{O}$). Amines (urea, guanidine), hydrocyanic acid, cyanide, cyanide complexes, toxicity. II.4.2. <i>Silicon.</i> Distribution. Properties of the element. Compounds. Organosilicon compounds, silicones. Glass. II.4.3. <i>Germanium, tin, lead.</i> Distribution. Properties of the elements. Compounds. Toxicity	4
	II.5. GROUP 5A II.5.1. <i>General Characteristics. Nitrogen.</i> Distribution. Properties of the element. Fixation of atmospheric nitrogen (concept). Compounds. Ammonia, aqueous ammonia, ammonium salts. Nitric acid. Biological relevance, environmental issues. Nitrogen cycle in nature. Concept of nitrogen fertilizers. II.5.2. <i>Phosphorus.</i> Distribution. Properties of the element. Compounds. Phosphoric acid. Macroenergetic compounds, ATP (concept of structure and properties). Concept of phosphate fertilizers. II.5.3. <i>Arsenic, antimony, bismuth.</i> Distribution. Compounds. Marsh test. Biological relevance (biological functions toxicity).	4

	II.6. GROUP 6A II.6.1. <i>General characteristics. Oxygen.</i> Distribution. Properties of the element. Biological relevance, role of steady state $O_2 \rightleftharpoons O_3$. Oxygen compounds. Water - properties, pyrogen-free water, heavy water. Peroxides, superoxides. Concept of biological action of the superoxide ion. II.6.2. <i>Sulphur.</i> Distribution. Properties of the element, allotropes, pharmacological applications. Oxides of sulphur. Hydrides: hydrogen sulphide, toxicity. Sulphides, disulphides (biological functions). Oxygen acids. Sulphur cycle in nature. II.6.3. <i>Selenium, tellurium, polonium.</i> Distribution. Properties of the elements. Compounds. Biological relevance (biological functions, toxicity), micro fertilizers. Insight into the biological activity of alpha emitters.	4
	II.7. GROUP 7A II.7.1. <i>General characteristics. Fluorine.</i> Distribution. Properties of the element. Compounds. Biological relevance (biological functions, toxicity). II.7.2. <i>Chlorine, bromine, iodine, astatine.</i> Distribution. Properties of the elements. Compounds. Biological relevance (biological functions, pharmacological administration, toxicity).	2
	II.8. GROUP 8A <i>General characteristics. Xenon.</i> Compounds	1
	III.d-and f-Elements. III.1. Group 1B. Copper. Properties of the element. Compounds in oxidation state I and II. Biological relevance (biological functions toxicity). <i>Silver and gold.</i> Properties of the elements. Compounds. Bactericidal properties of silver ions.	2
	III.2. Group 2B. Zinc, cadmium, mercury. Properties of the elements. Compounds with oxidation state II. Compounds of mercury with oxidation state I. Biological role of zinc; antiseptic properties of zinc compounds, toxicity of cadmium and mercury.	1
	III.3. Group 3B Scandium, yttrium, lanthanum. General characteristics. <i>Lanthanides:</i> correlation electronic configuration - properties. <i>Actinides:</i> description of the production of transuranic elements.	1
	III.4. Group 6B. Chromium, molybdenum, tungsten. Properties of the elements. Compounds. Biological significance of molybdenum, toxicity of chromium.	1
	III.5. Group 7B. Manganese. Distribution. Properties of the element. Oxides and hydroxides.	1
	III.6. Group 8B. General characteristics. Iron. Compounds. Hemoglobin. <i>Cobalt and nickel.</i> Compounds, complex	4

	compounds, Vitamin B12. Biological relevance (biological functions, pharmacological administration, toxicity). <i>Platinum metals</i> . Compounds of palladium and platinum complexes, pharmacologically application.	
	Practical exercises	
1	Practical № 1 1. Safety in the chemical laboratory. 2. Stoichiometric calculations. Calculations on the theme Concentration of solutions.	2
2	Theme: Basic laboratory operations - preparation of a solution, precipitation, filtration, drying. Calculation of yield. Synthesis of sparingly soluble salts (carbonates, sulphates, oxalates) - (CaCO ₃ -exp.121, p.203; BaSO ₄ - exp.58, p.153; PbSO ₄ - exp.105, p.196; ZnC ₂ O ₄ - exp.76, p.178, NiCO ₃ - exp.71, p.172 (optional demonstration exercises).	2
3	Theme: Stoichiometric calculations. Solubility product, hydrolysis.	1
4.	Theme: Thermal dissociation of salts. Synthesis of oxides, hydroxides, peroxides: CaO - exp. 77, p 179; ZnO and Zn (OH) ₂ - exp. 76, p 178; CuO and Cu (OH) ₂ - exp. 78 p. 179, PbO - exp.82, p.182; MnO ₂ exp. 75, p.177; Fe (OH) ₃ and Fe ₂ O ₃ - exp.87, p. 186 (optional demonstration exercises)	3
5.	Theme: Properties of elements and their compounds. Group 2A - the properties of magnesium, barium – exp. 57 p.152; exp. 58, p 153.	1
6.	Theme: Groups 1B and 2B - Properties of copper and compounds – exp. 64, p. 163, of silver compounds – exp. 65, page 164, and zinc compounds - exp.66, p.166 (without preparation of ZnSO ₄).	3
7.	Theme: Properties of elements and their compounds. Group 3A - Preparation of boric acid, borate pearls (exp. 59, p.155) properties of aluminium and aluminium hydroxide (exp. 60, p.156).	2
8.	Theme: Properties of elements and their compounds. Group 4A. Properties of lead and compounds - exp. 61 p.157.	2
9.	Theme: Properties of elements and their compounds. Group 4A. Preparation of silicic acid - exp. 141 p.213.	2
10.	Theme: Properties of elements and their compounds Group 5A - Preparation and properties of ammonia and ammonium salts (exp. 62 p.159) oxidizing properties of HNO ₃ - exp. 74 p.175.	2
11.	Theme: Properties of elements and their compounds. Group 6A - Properties of H ₂ SO ₄ - exp. 73, p.174.	2
12.	Theme: Properties of elements and their compounds Group 7A - Halogens - exp. 63 p.161.	2

13.	Theme: Properties of elements and their compounds. Group 7B - Manganese - exp. 68, p.168.	2
14.	Theme: Properties of elements and their compounds. Group 8B - Properties of iron and its compounds - exp. 69, p 170.	2
15.	Theme: Properties of elements and their compounds. Group 8B - Properties of nickel and compounds - exp. 71, p.172.	2

Topics Covered on the Final Exam

Nº	Topic
1.	Hydrogen. Occurrence. Properties of the element. Ionic and covalent hydrides.
2.	GROUP 1A. <i>General characteristics. Lithium, sodium, potassium.</i> Occurrence. Properties of the elements. Compounds. Biological activity, applications.
3.	GROUP 2A. <i>General characteristics. Magnesium, calcium.</i> Occurrence. Properties of the elements. Compounds. Biological activity. Water hardness. Chemistry of photosynthesis
4.	GROUP 3A. <i>General characteristics. Boron.</i> Properties of the element. Compounds. Boric acid.
5.	<i>Aluminium.</i> Distribution. Properties of the element. Compounds. Double salts (alum).
6.	<i>Gallium, indium, thallium.</i> Distribution. Characteristics of the compounds of Tl (I), toxicity.
7.	GROUP 4A. <i>General characteristics. Carbon.</i> Distribution. Properties of the element. Compounds. Carbonic acid (equilibrium in the system CO ₂ - H ₂ O). Amines (urea, guanidine), hydrocyanic acid, cyanide, cyanide complexes, toxicity.
8.	<i>Silicon.</i> Distribution. Properties of the element. Compounds. Organosilicon compounds, silicones. Glass.
9.	<i>Germanium, tin, lead.</i> Distribution. Properties of the elements. Compounds. Toxicity
10.	GROUP 5A. <i>General Characteristics. Nitrogen.</i> Distribution. Properties of the element. Fixation of atmospheric nitrogen (concept). Compounds. Ammonia, aqueous ammonia, ammonium salts. Nitric acid. Biological relevance, environmental issues. Nitrogen cycle in nature. Concept of nitrogen fertilizers.
11.	<i>Phosphorus.</i> Distribution. Properties of the element. Compounds. Phosphoric acid. Macroenergetic compounds, ATP (concept of structure and properties). Concept of phosphate fertilizers.
12.	<i>Arsenic, antimony, bismuth.</i> Distribution. Compounds. Marsh test. Biological relevance (biological functions toxicity).
13.	GROUP 6A. <i>General characteristics. Oxygen.</i> Distribution. Properties of the element. Biological relevance, role of steady state O ₂ ⇌ O ₃ . Oxygen compounds. Water - properties, pyrogen-free water, heavy water. Peroxides, superoxides. Concept of biological action of the superoxide ion.
14.	<i>Sulphur.</i> Distribution. Properties of the element, allotropes, pharmacological applications. Oxides of sulphur. Hydrides: hydrogen sulphide, toxicity. Sulphides,

	disulphides (biological functions). Oxygen acids. Sulphur cycle in nature.
15.	<i>Selenium, tellurium, polonium</i> . Distribution. Properties of the elements. Compounds. Biological relevance (biological functions, toxicity), micro fertilizers. Insight into the biological activity of alpha emitters.
16.	GROUP 7A. <i>General characteristics. Fluorine</i> . Distribution. Properties of the element. Compounds. Biological relevance (biological functions, toxicity).
17.	<i>Chlorine, bromine, iodine, astatine</i> . Distribution. Properties of the elements. Compounds. Biological relevance (biological functions, pharmacological administration, toxicity).
18.	GROUP 8A <i>General characteristics. Xenon</i> . Compounds
19.	Group 1B. <i>Copper</i> . Properties of the element. Compounds in oxidation state I and II. Biological relevance (biological functions toxicity).
20.	<i>Silver and gold</i> . Properties of the elements. Compounds. Bactericidal properties of silver ions.
21.	Group 2B. <i>Zinc, cadmium, mercury</i> . Properties of the elements. Compounds with oxidation state II. Compounds of mercury with oxidation state I. Biological role of zinc; antiseptic properties of zinc compounds, toxicity of cadmium and mercury.
22.	Group 3B <i>Scandium, yttrium, lanthanum</i> . General characteristics.
23.	<i>Lanthanides</i> : correlation electronic configuration - properties.
24.	<i>Actinides</i> : description of the production of transuranic elements.
25.	Group 6B. <i>Chromium, molybdenum, tungsten</i> . Properties of the elements. Compounds. Biological significance of molybdenum, toxicity of chromium.
26.	Group 7B. <i>Manganese</i> . Distribution. Properties of the element. Oxides and hydroxides.
27.	Group 8B. <i>General characteristics. Iron</i> . Compounds. Hemoglobin.
28.	<i>Cobalt and nickel</i> . Compounds, complex compounds, Vitamin B12. Biological relevance (biological functions, pharmacological administration, toxicity).
29.	<i>Platinum metals</i> . Compounds of palladium and platinum complexes, pharmacologically application.

Bibliography

Main sources:

- 1.Kirkova, E., Chemistry of the elements and their compounds, Univ. Press "St. Kl. Ohridski ", Sofia, 2013.
- 2.Lazarov, D. Chemistry. Univ. Press "St. Kl. Ohridski ", Sofia, 1999.
- 3.Genov, L., M. Maneva-Petrova. Inorganic Chemistry, Part II. Martilen, S., 1993.
- 4.Dafinova, R., E.Radkov, St. Manev, V.Pelova. Laboratory exercises and assignments in inorganic chemistry. Univ. Press "St. Kl. Ohridski ", Sofia, 2000

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