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# **CHEMISTRY DEPARTMENT**

# **Information booklet**

First cycle studies

BANJA LUKA, 2020



Chemistry study program was established as Chemistry Department at Faculty of Natural Sciences and Mathematics at 1997. By accepting the principles of the Bologna process, in 2007, teaching at first cycle is organized within two programs: Chemistry and Chemistry Education. Since its establishment, 238 students have graduated at Chemistry Department (including the pre-bologna period), of which 102 students graduated as a Bachelor of Science in Chemistry and 136 graduated as Teacher of Chemistry (December 2020).

After the introduction of the principles of the Bologna Declaration in the study system at the University of Banja Luka, the interest of candidates for enrollment in the first cycle of chemistry studies has

obviously increased.

Currently, at first cycle of studies at Chemistry Department study 97 students. Students used for classes and practice classrooms and laboratories at Faculty of Natural Sciences and Mathematics, as well as some appropriate laboratories at University.





The Department employs seven full-time teachers, four assistants, four laboratory technicians and four professional associates, and teachers and associates form other faculties of the University of Banja Luka, as well as visiting professors from University of Belgrade and University of East Sarajevo. Head of the Department is Assoc. Prof. Dr. Milica Balaban.

Chemistry Department is organized by model 4+1+3. This model implies that studies at first cycle are performed in eight semesters or four years. The number of ECTS credits per year of study is 60, so that a student achieves 240 ECTS credits upon completion of undergraduate studies. Undergraduate studies of chemistry consist of required and elective courses, which provide knowledge and skills necessary for obtaining diploma for the first cycle of academic studies. Studies at Chemistry Department are organized within two programs: *Chemistry* and *Chemistry Education*.



Courses at first two years of studies are common for both programs, while at third and fourth years the programs differ significantly. First cycle of studies at Chemistry Department consists of a total 39 courses, 31 are required and 8 elective subjects. For every elective course, student can choose between two offered courses.

After completing of first cycle of studies at the Chemistry Department, students acquire the following academic title:

*Bachelor of Science in Chemistry - 240 ECTS*, for the students of *Chemistry* program and *Graduated Teacher of Chemistry - 240 ECTS*, for the students of *Chemistry Education* program

### OBJECTIVES OF THE PROGRAM AND ACQUIRED COMPETENCES

**Objectives** of first cycle studies at Chemistry Department are defined as:

- Education of experts in different fields of chemistry fields.
- Education of experts competent to work in research laboratories in chemistry field and related sciences.
- Education of chemistry teachers for work in elementary schools and high schools, through chemistry subjects and chemistry teaching methodology.
- Education of experts for work in institutions and industry where profession knowledge, advice and recommendations in chemistry field are required.
- Providing a modern educational program with an emphasis on adoption of fundamental knowledge, as well as latest achievements in chemistry and related sciences.
- Encouraging creative thinking, problem-solving methodology and the use of the latest information technologies in learning process and presenting acquired knowledge.

After graduation, our students possess *competencies* that qualify them for successful career in educational and scientific institutions, as well as various economic branches. Graduated chemistry students are

- able to adopt, analyze and synthesize basic knowledge in chemistry and related natural sciences;
- capable to practically apply chemical knowledge through work in chemical laboratories of general type and quality control departments of various industries;





- capable to work in scientific research laboratories;
- can effectively transfer appropriate chemical knowledge and information in elementary and high schools and other uninformed audience;
- possess skills for collecting and processing, as well as evaluation and interpretation chemical data and other information;
- able to exchange information, ideas, problems and solutions;
- able for teamwork;
- can form scientifically based and well-argued attitudes based on knowledge of chemistry laws;
- acquired the ability of effective profession communication in chemistry field;
- build the learning skills necessary for engaging in further chemistry education.

At Chemistry Department, teaching and scientific activities are organized within several chemistry fields that belongs to natural and related sciences such as inorganic, analytical, physical and organic chemistry, as well as biochemistry and nanochemistry, and, in general, material science.



Our department is characterized by the fact that it carefully incorporates *interdisciplinary* and *multidisciplinary approaches*, so that scientists who formally belong to different fields, conduct mutual research focused on one specific scientific problem from different aspects.

Chemistry students get involved in scientific and professional work very early through participation in project, scientific conferences and various promotional activities that are often organized. Practice has





shown that our graduates are very easily involved in the work of scientific research laboratories and continue their education in field of chemistry.

Students from Chemistry Department participate in numerous scientific conferences, where they are noticed and often win awards and recognitions.





At Chemistry Department, special attention is dedicated to education of chemistry teachers and their teaching profession, so considerable effort is invested in improving the competencies of future chemistry teachers. Team from Chemistry Department **"ChemSTEM"** is very active in promoting STEM (*Science, Technology, Engineering & Mathematics*) activities through realization of projects Enable B&H and "Improving STEM skills in the Republic of Srpska, B&H".

During all four years of studies, students have the opportunity to visit many factories, institutes and institutions in the country, where they take professional practice and do practical part of their final works.





In the last few years, our students and junior associates within the international projects we participate can perform part of the training in various laboratories and other partner organizations abroad.



Also, our students are very active in different social activities, as well as activities which have goal to popularize chemistry among the younger generations.







## CURRICULUM

### Bachelor of Science in Chemistry- 240 ECTS

	FIRST	(EAR		
Required course				
Course	l semester	ECTS	II semester	ECTS
1. Mathematics 1	2+2	6		
2. Physics 1	3+3	6		
3. Stoichiometry	1+3	6		
4. General Chemistry	3+2	7		
5. Basic of Computer Science	2+2	5		
6. Inorganic Chemistry			3+3	8
7. Mathematics 2			2+2	7
8. Physics 2			3+3	7
9. Analytical Chemistry 1			3+4	8
Hours of instruction	11+12		11+12	
Total hours	23		23	
Total ECTS		30		30
Number of exams	5 4			
Number of exams per year	9			

SECOND YEAR				
Required course				
Course	III semester	ECTS	IV semester	ECTS
1. Organic Chemistry 1	3+3	8		
2. Physical Chemistry 1	3+3	7		
3. Analytical Chemistry 2	3+4	7		
4. Environmental Chemistry	3+0	5		
5. English Language 1	2+1	3		
6. Organic Chemistry 2			4+3	8
7. English Language2			2+1	3
8. Physical Chemistry 2			2+3	7
<ol> <li>Selected Topics of Inorganic Chemistry</li> </ol>			3+2	6
10. Sampling and Sample Preparation for Chemical Analysis			2+3	6
	· · · · · · · · · · · · · · · · · · ·		· · · · ·	
Hours of instruction	14+11		13+12	
Total hours	25		25	
Total ECTS		30		30
Number of exams	5 5		j	
Number of exams per year	10			



THIRD YEAR				
Course	V semester	ECTS	VI semester	ECTS
1. Theoretical Organic Chemistry	3+2	7		
2. Industrial Chemistry 1	3+3	7		
3. Chromatographic Methods	2+2	6		
4. Elective course 1	2+2	5		
5. Elective course 2	2+2	5		
6. Industrial Chemistry 2			2+2	5
7. Chemistry of Natural Products			3+2	6
8. Physical Chemistry 3			2+2	5
9. Spectroscopy of Organic Compounds			3+2	6
10. Elective course 3			2+2	4
11. Elective course 4			3+0	4
Hours of instruction	12+11		15+10	
Total hours	23		25	
Total ECTS		30		30
Number of exams	5	5	6	
Number of exams per year	11			

Elective courses:	
Elective course 1	a) Chemical kinetics and catalysis
	b) Electrochemistry
Elective course 2	a) Coordination Chemistry
	b) Inorganic Synthesis
Elective course 3	a) Applied Organic Chemistry
	b) Nomenclature of Organic Compound
Elective course 4	a) Computational Chemistry
	b) Quantum Chemistry



FOURTH YEAR				
Courses	VII semester	ECTS	VIII semester	ECTS
1. Biochemistry 1	3+3	7		
2. Nanochemistry	3+2	6		
3. Instrumental Methods	3+3	7		
4. Elective course 5	2+2	5		
5. Elective course 6	2+2	5		
6. Biochemistry 2			3+3	6
7. Solid State Chemistry			3+2	6
8. Elective course 7			2+1	4
9. Elective course 8			3+3	6
Graduate Thesis				8
Hours of instruction	13+12		11+9	
Total hours	25		20	
Total ECTS		30		30
Number of exams	5 4		ŀ	
Number of exams per year	er year 9			

Elective courses:	
	a) Colloidal Chemistry
Elective course 5	b) Photochemistry
Elective course 6	a) Chemistry of Synthetic polymers
	b) Organic Synthesis
Elective course 7	a) Standard and Standardization
	b) Processes in Chemical Industry
Elective course 8	a) Chemistry of Water
	b) Nuclear Chemistry
Graduate Thesis	



## Graduated Teacher of Chemistry - 240 ECTS

	FIRST	/EAR		
Required course				
Course	l semester	ECTS	II semester	ECTS
1. Mathematics 1	2+2	6		
2. Physics 1	3+3	6		
3. Stoichiometry	1+3	6		
4. General Chemistry	3+2	7		
5. Basic of Computer Science	2+2	5		
6. Inorganic Chemistry			3+3	8
7. Mathematics 2			2+2	7
8. Physics 2			3+3	7
9. Analytical Chemistry 1			3+4	8
Hours of instruction	11+12		11+12	
Total hours	23		23	
Total ECTS		30		30
Number of exams	5 4			
Number of exams per year	9			

SECOND YEAR				
Required course				
Course	III semester	ECTS	IV semester	ECTS
1. Organic Chemistry 1	3+3	8		
2. Physical Chemistry 1	3+3	7		
3. Analytical Chemistry 2	3+4	7		
4. Environmental Chemistry	3+0	5		
5. English Language 1	2+1	3		
6. Organic Chemistry 2			4+3	8
7. English Language2			2+1	3
8. Physical Chemistry 2			2+3	7
<ol> <li>Selected Topics of Inorganic Chemistry</li> </ol>			3+2	6
10. Sampling and Sample Preparation for Chemical Analysis			2+3	6
Hours of instruction	14+11		13+12	
Total hours	25		25	
Total ECTS		30		30
Number of exams	5 5			
Number of exams per year	10			



THIRD YEAR				
Course	V semester	ECTS	VI semester	ECTS
1. Organic Chemistry 3	3+2	7		
2. Psychology	2+2	5		
3. Chromatographic Methods	2+2	6		
4. Elective course 1	2+2	6		
5. Elective course 2	2+2	6		
6. Pedagogy			2+2	5
7. Chemistry of Natural Products			3+2	6
8. Physical Chemistry 3			2+2	5
9. Spectroscopic of Organic Compounds			3+2	6
10. Elective course 3			2+2	4
11. Elective course 4			3+0	4
Hours of instruction	11+10		15+10	
Total hours	21		25	
Total ECTS		30		30
Number of exams	5		6	
Number of exams per year	11			

Elective courses:	
Elective course 1	a) Chemical kinetics and catalysis
	b) Electrochemistry
Elective course 2	a) Coordination Chemistry
	b) Inorganic Synthesis
Elective course 3	a) Applied Organic Chemistry
	b) Nomenclature of Organic Compound
Elective course 4	a) Computational Chemistry
	b) Quantum Chemistry



FOURTH YEAR				
Courses	Courses	Courses	Courses	Courses
1. Biochemistry 1	3+3	7		
2. Chemistry Didactics 1	2+3	6		
3. School Experiments in Chemistry Teaching	2+4	7		
4. Elective course 5	2+2	5		
5. Elective course 6	2+2	5		
6. Biochemistry 2			3+3	6
7. Chemistry Didactics 2			2+4	6
8. Elective course 7			3+3	6
9. Elective course 9			2+0	4
Graduate Thesis				8
Hours of instruction	11+14		10+10	
Total hours	25		20	
Total ECTS		30		30
Number of exams	5 4			
Number of exams per year	9			

Elective courses:	
	a) Colloidal Chemistry
Elective course 5	b) Photochemistry
Elective course 6	a) Chemistry of Synthetic polymers
	b) Organic Synthesis
Elective course 7	a) Chemistry of Water
	b) Nuclear Chemistry
Elective course 8	a) History of Chemistry
	b) Multimedia Resources for Teaching Chemistry
Graduate Thesis	



#### *Qualification exam for first cycle studies at Chemistry Department*

Qualification exam at Chemistry Department carries 50 point and includes tests in chemistry (25 points) and mathematics (25 points), which are written in front of appointed Commission. The minimum number of points that allows ranking of candidates and enrollment at the first year of studies is 15. Candidates for the qualification exam should bring and identification document (ID card or passport) and show it at the request of the Commission member, who also acquaint candidates with the procedure exam. Another 50 points for ranking candidates on the final list ate taken as the average grade of the previous education level, from the documents that candidates bring when applying for the qualification exam. The results of the exam and further procedure are prescribed by the competition.

#### Preparatory classes for the enrollment at the first cycle of studies at Chemistry Department



Preparatory classes for enrollment at the first cycle studies at Chemistry Department are organized in chemistry and mathematics, subjects that candidates do at qualification exam. Preparatory classes in chemistry include solving problems from the Workbook for the preparation of the qualification exam in chemistry, with the addition of chemistry books from high school. The duration of preparatory classes in chemistry is 20 hours (5 days x 4 hours), and it is organized, as a rule, in the week preceding the qualification exam. Preparatory classes in mathematics are organized in the same week and take equal duration - 20 hours (5 days x 4 hours).



## Examples of qualification exam in chemistry

Univerzitet u Banjoj Luci					
Prirodno-matematički fakultet					
Studijsl	ci program hemija				
	<b>KVALIEIKACIONI ISPIT IZ HEMIJE</b>				
KVALIFIKACIONI ISPIT IZ HEMIJE 28.6.2010					
	20.0.2017.				
1.	Zaokružiti niz u kome se vrijednost energije jonizacije povećava s lijeva na desno:				
	a) Li, Na, K, Rb, Fr b)Ba, Sr, Ca, Mg, Be c) Li, Be, Na, K, He				
2.	Koje od navedenih jedinjenja može da obrazuje vodoničnu vezu?				
	a) CH <sub>3</sub> OH b) SbH <sub>3</sub> c) HCl $_{(g)}$ d) NaH				
3.	3. Koliko cm <sup>3</sup> vode treba ispariti iz 250 cm <sup>3</sup> rastvora koji sadrži 2,5 g/dm <sup>3</sup> NaOH da bi se dobio rastv				
	čija je količinska koncentracija 0,8 mol/dm³?				
4.	. Izračunati koncentraciju H+ jona u rastvoru u kome je koncentracija OH- jona 7,4 · 10-11 mol/dm3.				
5.	5. Koliki je osmotski pritisak rastvora glukoze, količinske koncentracije 0,02 mol/dm <sup>3</sup> , na temperaturi od				
	278 K? Univerzalna gasna konstanta iznosi R = 8,314 J/molK.				
6.	6. Oksidacija u organskoj hemiji predstavlja povećanje elektronske gustine na ugljeniku, što se ogleda u:				
	a) formiranju C-H veze i raskidanju C-O, C-X, C- N veza				
	б) formiranju C- R veze i raskidanju C- O, C-N, C-X, veza				
	в) formiranju C-O, C-X, C- N veze i raskidanju C-H veza				
7.	Imenovati prikazane alkane u skladu sa IUPAC-ovom nomenklaturom:				
	a) c)				
	CH <sub>3</sub> -CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>3</sub>				
	b)				
	$CH_3$ $CH_3 - CH - CH - CH_3$				
	cH <sub>3</sub> cH <sub>2</sub>				
	CH <sub>3</sub>				
8.	Zaokružite slovo ispred niza u kome su prisutni derivati karboksilnih kiselina.				
	a) estri, acil-halogenidi, anhidridi, amini				
	b) etri, anhidridi, amidi, alkil-halogenidi				
	c) estri, acil-halogenidi, anhidridi, amidi				
9.	Napisati reakciju nastajanja gliceril-triplamitata.				
10.	. Masti i ulja su:				
	a) etri				
	b) estri				
	c) amidi				
	d) anhidridi				



Prirodno-matematički fakultet Gtudijski program hemija					
		1.7.2020.			
1.	Pozicija elementa u periodnom sistemu elemenata, odnosno, njegov broj grupe daje podatak o . broju				
	u posljednjoj valentnoj ljusci, a broj periode o broju				
2.	Kolika je količinska koncentracija rastvora natrijum-karbonata, ako se u 500 cm <sup>3</sup> rastvora nalazi 4 g natrijum-karbonata?				
3.	, Izračunati koncentraciju H+ jona u rastvoru u kome je koncentracija OH- jona 7,4 × 10-11 mol/dm³.				
4.	4. Odrediti oksidacione brojeve svih elemenata u sljedećim jedinjenjima:				
	a) MnO <sub>2</sub> b) KMnO <sub>4</sub>	c)K <sub>2</sub> MnO <sub>4</sub>	d) MnSO <sub>4</sub>		
5.	5. Napisati koji tip hibridizacije je karakterističan za sljedeće grupe ugljovodonika:				
	a) alkani	hibri	dizacija		
	b) alkini	b) alkini hibridizacija			
	c) alkeni	hibri	dizacija		
6.	Imenovati prikazane alkane				
	(u skladu sa IUPAC-ovom nomenklaturom):				
	a)	c)			
	, 	,			
	$CH_3 - CH_2 - CH_2 - CH_2 - CH_3$	$\frown$	$\checkmark$		
	b)				
	CHa				
	CH <sub>3</sub>				
7.	Nacrtati strukture sljedećih ketona:				
	a) aceton	c) cikloheksen-	2,5-dion		
	b) 4-fenil-2-butanon				
8.	Koje jedinjenje može nastati reakcijom hlorovanja metana?				
	a) etilhlorid	c) eten			
	b) hloroform				
9.	Optički aktivne supstance posjedu	ıju	C atom, koji za sebe ima vezane		
	funkcionalne	grupe.			
10.	. Proteini se izgrađuju povezi <sup>.</sup>	vanjem	grupe jedne aminokiseline		



Univerzitet u Banjoj Luci					
Prirodno-matematički fakultet					
Studijski program hemija					
KVALIFIKACIONI ISPIT IZ HEMIJE					
07.09.2020.					
1. Koliko se jona nalazi u 5 g $H_2O$ ?					
2. Atom se sastoji:					
a) samo od jezgra	b) samo od omotača c) od jezgra i omotača				
3. U kojem od navedenih jedinjenja je prisutna jonska veza?					
a) CH <sub>4</sub> b) As	sI <sub>3</sub> c) PH <sub>3</sub> d) BaCl <sub>2</sub>				
4. Odrediti pH rastvora koji nastaje mi	iješanjem 30 cm <sup>3</sup> rastvora hlorovodonične kiseline, količinske				
koncentracije 0.1 mol/dm <sup>3</sup> i 40 cm <sup>3</sup> rastvora natrijum bidroksida količinske koncentracije 0.1					
1/1 3					
5 Koia od pavodopih voza je pajduža?					
5. Koja od navedenih veza je najduza?					
b) dvostruka	c) trostruka				
6 Nacrtati struktura <i>trans</i> i <i>cis</i> izomara sl	liedećih iedinienia:				
a) 2 motil 2 monton					
u) 5 metri 2 penten	b) i biolit i buch				
7. Identifikovati funkcionalne grupe prikazanih jedinjenja:					
a) o	b)				
$CH_3 \cdot CH_2 - CH_2 - CH_2 - C \equiv N$ OH					
8. Na koji način su hibridizovani ugljenikovi atomi u etenu?					
9. Aminokiseline posjeduju dvije karakteristične funkcionalne grupe:					
a) karboksilnu i hidroksilnu					
b) amino- ihidroksilnu					
c) karboksilnu i amino-					
d) keto- i hidroksilnu					
10. Neutralne masti su po hemijskoj prirodi estri izgrađeni od masnih kiselina i alkohola:					
a) etanola	c) glicerola				
b) etandiola	d) metanola				



Examples in qualification exam in mathematics

#### Математика

- 1. Ципеле коштају 225 KM. Прво су поскупиле 20%, па су онда појефтиниле 20%. Колико сада коштају ципеле?
- 2. Рјеши једначину  $3^{x^2-x} = 9$ .
- 3. Ана, Беба и Цеца су заједно уплатиле тикет у кладионици. Ана је уплатила једну, Беба двије а Цеца три марке (укупно су уплатиле шест марака). Њихов добитак је 1032 марке. Како да поштено подијеле добитак?
- 4. Ријеши неједначину  $\frac{x^2 4}{x 3} > 0.$
- 5. Ако је $a=\frac{1}{2}$ а $b=\frac{1}{3},$ израчунај

$$\frac{1}{a+b} \cdot \left(\frac{1}{a^2} - \frac{1}{b^2}\right) \cdot \frac{ab}{a-b}.$$



Име и презиме

#### УНИВЕРЗИТЕТ БАЊА ЛУКА ПРИРОДНО-МАТЕМАТИЧКИ ФАКУЛТЕТ СТУДИЈСКИ ПРОГРАМ ЗА ХЕМИЈУ

#### ПРИЈЕМНИ ИСПИТ 27. 6. 2016. Тест из математике

- 1. Вриједност израза  $\frac{a^3 b^3}{a + b \frac{ab}{a+b}} \frac{a^3 + b^3}{a b + \frac{ab}{a-b}}$  је A) 0 Б) a В) 1 Г) 2.
- 2. Број рјешења једначине |2x+1|+|x-4|-6=0 је

A) 1 Б) 2 B) 3 Г) 4

3. Вриједност израза

 $100^2 - 99^2 + 98^2 - 97^2 + \dots + 4^2 - 3^2 + 2^2 - 1^2$ 

је једнака

A) 5008 B) 5054 B) 5050 Γ) 5500.

4. Рјешење једначине logx + log(x + 3) = log(6 + 2x) је број

A) 1 B) 2 B) 3  $\Gamma$ ) 4.

5. Број рјешења једначине  $(\sin x + \cos x)^2 = 1 + 4 \sin x \cos^2 x$  у интервалу  $[0, \pi]$  је

A) 4 B) 3 B) 5  $\Gamma$ ) 6.

- 6. Пресјечне тачке парабола  $y = 3x^2 6x + 8$  и  $y = 2x^2 x + 2$ су
  - A) (-3, 10) u (5, 8) B)(8, 9) u (3, 10) B)(2, 8) u (3, 17) C) $(5, 8) \cap (3, 14)$ .
- 7. Збир свих рјешења једначине  $3 \cdot 16^x + 2 \cdot 81^x = 5 \cdot 36^x$  једнак је
  - A) 1 B) 2 B) 0  $\Gamma$ )  $\frac{1}{2}$ .
- 8. Ако је ивица коцке  $\sqrt{2}$  полупречник лопте која додирује свих дванаест ивица коцке је

A)  $\frac{1}{2}$  B)  $\frac{\sqrt{2}}{2}$  B) 1  $\Gamma$ )  $\sqrt{0.4}$ .

9. Прије пет година отац је био пет пута старији од сина, а послије три године ће отац бити три пута старији од сина. Колико година сада имају син и отац?

А) 10 и 40 Б) 8 и 11 В) 13 и 45 Г) 18 и 52.

10. На тениском турниту је било  $2^n$  такмичара. Игра се куп-систем (ко изгуби испада, побједник иде даље). Сваки меч се игра до три добијена сета. Ако је на цијелом турниру одиграно  $2^{n+1} + 4n^2 + 187$  сетова, број такмчара на турниру је

A) 32 B) 256 B) 64  $\Gamma$ ) 512.