

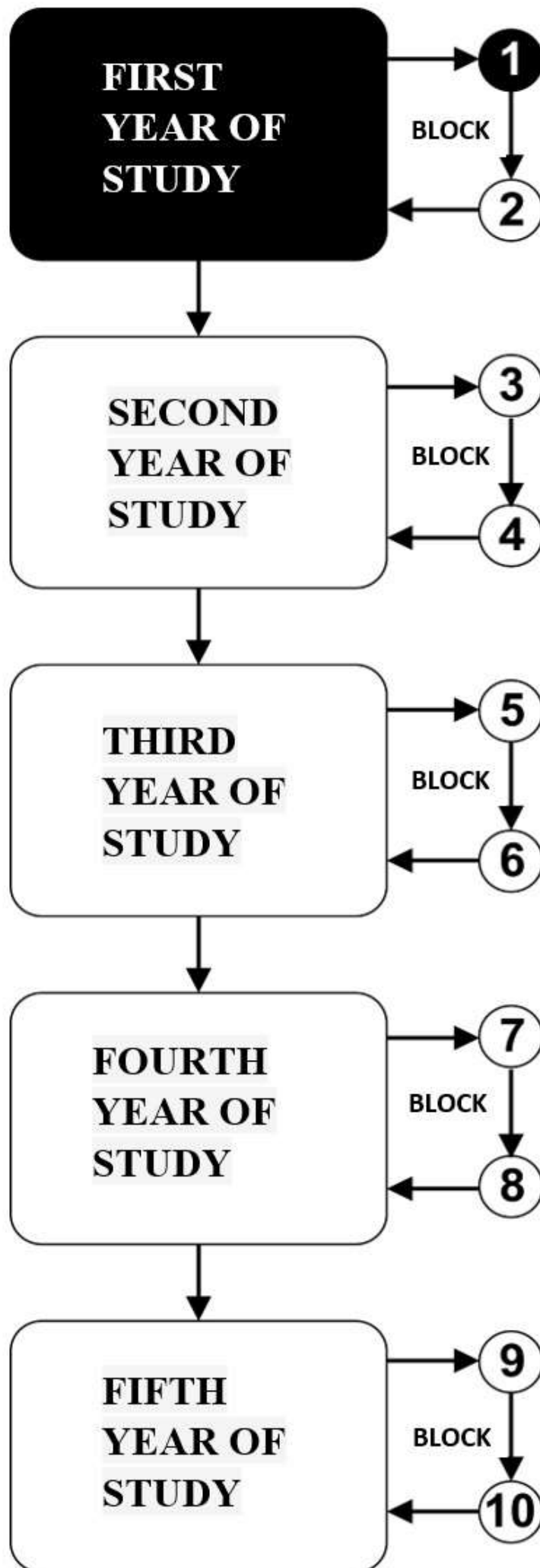


**INTEGRATED ACADEMIC  
PHARMACY STUDIES**

**FIRST YEAR OF STUDY**

academic 2023/2024.

**ANALYTICAL CHEMISTRY**



Course:

## **ANALYTICAL CHEMISTRY**

The course is evaluated with 8 ESPB. There are 6 hours of active teaching per week (4 hours of lectures and 2 hours of work in a small group).

## TEACHERS AND ASSOCIATES:

	Име и презиме	Email address	title
1.	Marija D. Živković	mzivkovic@kg.ac.rs	Associate Professor
2.	Snežana Jovanović	snezana.j@kg.ac.rs	Assistant professor
3.	Andriana M. Bukonjić	andriana.bukonjic@medf.kg.ac.rs	Assistant Professor
4.	Dušan Lj. Tomović	dusantomovic@medf.kg.ac.rs	Assistant Professor
5.	Ana S. Živanović	ana_Živanović@outlook.com	Facilitator

## COURSE STRUCTURE:

Module	Module name	Week	Lectures	Work in a small group	Teacher-supervisor module
1	Qualitative chemical analysis	7	4	2	Prof. dr Marija D. Živković
2	Quantitative chemical analysis	8	4	2	Prof. dr Marija D. Živković
					Σ 60+30=90

## EVALUATION:

Студент савладава предмет на основу поена остварених на предиспитним активностима и завршном тесту. Оцена је еквивалентна броју стечених поена (види табеле). Поени се стичу на следећи начин: The student overcomes the course based on the points achieved in the pre-examination activities and the final test. The score is equivalent to the number of gained points (see tables). Points are earned as follows:

**ACTIVITY DURING CLASSES:** The student can gain up to 30 points by taking 2 exam question from that week, answering and receiving 0-2 points in accordance with the demonstrated knowledge.

**FINAL EXAM:** The student can gain up to 70 points

Module		MAXIMUM POINTS		
		Activity during classes	Final exam	Σ
1	Qualitative chemical analysis	14		<b>14</b>
2	Quantitative chemical analysis	16		<b>16</b>
	Final exam		70	<b>70</b>
Σ		30	70	<b>100</b>

### The final grade is formed as follows:

In order to pass the course, student must gain a minimum of 51 points and pass all the modules.

To pass the module the student must:

1. Gain more than 50% of the points in that module
2. Gains more than 50% of the points provided for teaching activity in each module
3. Pass the module test, ie to have more than 50% correct answers.

NUMBER OF POINTS GAIN	MARK
0 - 50	<b>5</b>
51 – 60	<b>6</b>
61 – 70	<b>7</b>
71 – 80	<b>8</b>
81 – 90	<b>9</b>
91 - 100	<b>10</b>

# **TESTS BY MODULES**

## **FINALE TEST**

**FINALE TEST  
0-70 POINTS**

## **EVALUATION OF FINAL TEST**

The test has 35 questions  
Each question is worth 2 points

# THE PROGRAM:

## FIRSTH MODULE: Qualitative methods of analysis

### TEACHING UNIT 1 (FIRST WEEK):

#### INTRODUCTION TO ANALYTICAL CHEMISTRY AND ITS SIGNIFICANCE. THEORETICAL FUNDAMENTALS OF CHEMICAL METHODS OF ANALYSIS.

lectures 4 hours	work in a small group for 2 hours
Analytical chemistry Qualitative and quantitative analysis Division of analytical methods Significance and role of analytical chemistry Theoretical foundations of chemical methods Dissolution of substances (polar solvents, water and water dissolution, non-polar solvents)	Introduction to experimental work

### TEACHING UNIT 2 (SECOND WEEK):

#### SOLUTIONS (CONCENTRATION AND ACTIVITY). CHEMICAL EQUILIBRIUM

lectures 4 hours	work in a small group for 2 hours
The composition of the solution Substance quantity and concentration Activity Chemical equilibrium (law of mass action, equilibrium constant, influence on equilibrium, conditional equilibrium constants)	Preparation of a solution of a specific concentration. Computational tasks

### TEACHING UNIT 3 (THIRD WEEK):

#### ACID-BASE REACTIONS

lectures 4 hours	work in a small group for 2 hours
Acids and bases Reactions between acid and base Dissociation of acids and bases (solvent effect) pH, Hydrolysis, Buffers	

### TEACHING UNIT 4 (FOURTH WEEK):

#### COMPLEX FORMATION REACTIONS. PRECIPITATION REACTIONS.

lectures 4 hours	work in a small group for 2 hours
Equilibria in solutions of complexes Complex stability constants Analytically significant complexes, Influence of side reactions Formations of complexes and nature of metal ions and ligands Precipitation reactions (solubility product, solubility of precipitates in pure water, Influence of common ion, Influence of different ions, Influence of side reactions on solubility, Precipitation and ion separation by controlling the concentration of the precipitating reagent)	

## TEACHING UNIT 5 (FIFTH WEEK):

**REDOX REACTIONS**

lectures 4 hours	work in a small group for 2 hours
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Oxidation and reduction. Electrode potential.  
Nernst's equation. Influence of solution acidity on electrode potential.  
Standard electrode potential

## TEACHING UNIT 6 (SIXTH WEEK):

**КВАЛИТАТИВНА ХЕМИЈСКА АНАЛИЗА**

lectures 4 hours	work in a small group for 2 hours
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Complete and partial analysis  
Elementary, functional and molecule analysis.  
Phase analysis  
Analytical reactions  
Reagents and reagents  
Separations and masking in qualitative analysis  
Analysis of cations of the first and second groups

Confirmatory tests for the cations of the first and second analytical groups

## TEACHING UNIT 7 (SEVENTH WEEK):

**ANALYSIS OF CATIONS AND ANIONS**

lectures 4 hours	work in a small group for 2 hours
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Analysis of cations of the third, fourth and fifth groups.  
Anion analysis

Confirmatory tests for the cations of the third, fourth and fifth analytical groups. Confirmatory tests of anions

**SECOND MODULE:** Quantitative chemical analysis (volumetric methods of analysis, calculations in volumetry, acidimetry, alkalimetry, complexometry, precipitation titrations, oxidimetry and reductometry, gravimetric methods of analysis)

## TEACHING UNIT 8 (EIGHTH WEEK):

**QUANTITATIVE CHEMICAL ANALYSIS. VOLUMETRIC METHODS OF ANALYSIS**

lectures 4 hours	work in a small group for 2 hours
Division of volumetric methods of analysis Conditions of chemical reactions Equivalent and end point of titration Changes in reactant concentration during titration. Titration curves Indicators in volumetric titration Standard solutions in volumetry Primary solutions Volumetric determination techniques	Preparation of standard solution. Calculations.



TEACHING UNIT 9 (NINTH WEEK):

### CALCULATIONS IN VOLUMETRY

lectures 4 hours	work in a small group for 2 hours
Calculating the amount of a substance Calculation of the mass of the titrated substance and its mass fraction in the sample Calculation of solution concentration in standardization Dilution calculations Calculations at retitrations	Calculations in volumetry.

TEACHING UNIT 10 (TENTH WEEK):

### ACIDYMETRY AND ALKALIMETRY

lectures 4 hours	work in a small group for 2 hours
Методе засноване на киселинско-базним реакцијама Титрација јаких киселина или јаких база Титрација слабих киселина или слабих база Титрације смесе киселина или база Титрације полипротичних киселина или база Примена киселобазних титрација	Кисело-базне титрације.

TEACHING UNIT 11 (ELEVENTH WEEK):

### COMPLEXOMETRY

lectures 4 hours	work in a small group for 2 hours
Methods based on complex construction reactions EDTA as a chelating reagent The composition of the EDTA solution as a function of pH. Distribution diagram EDTA complexes with metals. Stability constants Titration curves Determination of finale point of titration (FPT) Metal indicators Application of complexometry	Complexometric titrations.

TEACHING UNIT 12 (TWELVE WEEK):

### PRECIPITATION TITRATIONS

lectures 4 hours	work in a small group for 2 hours
Methods based on precipitation reactions Argentometry Other precipitation titrations Application of argentometric titrations	Precipitation titrations.

TEACHING UNIT 13 (THIRTEENTH WEEK):

**OXIDIMETRY AND REDUCTOMETRY**

lectures 4 hours	work in a small group for 2 hours
Methods based on redox reactions. Titration curves Redox indicators Division of redox method Permanganometry	Oxidimetry and reductometry.

TEACHING UNIT 14 (FOURTEENTH WEEK):

**APPLICATION OF REDOX-TITRATION**

lectures 4 hours	work in a small group for 2 hours
Cerimetry Dichromatometry Bromatometry Iodatometry Iodine titrations	Redox titrations.

TEACHING UNIT 15 (FIFTEENTH WEEK):

**GRAVIMETRIC METHODS OF ANALYSIS**

lectures 4 hours	work in a small group for 2 hours
Sedimentation and particle size of sediment Colloidal sediments Crystalline sediments Precipitation from homogeneous solutions Sediment aging Coprecipitation Deposition with corrector Filtration Sediment leaching Drying and annealing of sediments Water in solids Precipitation reagents Indirect gravimetric analysis Calculations in gravimetry	Some examples of gravimetric determinations. Calculations in gravimetry.



## TEACHING SCHEDULE FOR THE COURSE ANALYTICAL CHEMISTRY

module	week	date	time	place	type	the name of the method unit	teacher
1	1	17.09.	15:40-19:00			Introduction to analytical chemistry and its significance. Theoretical foundations of chemical methods of analysis.	Prof. Dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		19.09.	08:00-14:00			Introduction to experimental work.	doc. Dr. Andriana M. Bukonjic doc. Dr. Dusan Lj. Tomovic Doc. Dr. Snežana Jovanović
	2	24.09.	15:40-19:00			Solutions (concentration and activity). Chemical equilibrium.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		26.09.	08:00-14:00			Preparation of a solution of a specific concentration. Computational tasks.	doc. Dr. Andriana M. Bukonjic doc. Dr. Dusan Lj. Tomovic Doc. Dr. Snežana Jovanović
	3	01.10.	15:40-19:00			Acid-base reactions	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		03.10.	08:00-14:00			Acid-base reactions	doc. Dr. Andriana M. Bukonjic doc. Dr. Dusan Lj. Tomovic Doc. Dr. Snežana Jovanović
	4	08.10.	15:40-19:00			Complex construction reactions. Precipitation reactions.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		10.10.	08:00-14:00			Complex construction reactions. Precipitation reactions.	doc. Dr. Andriana M. Bukonjic doc. Dr. Dusan Lj. Tomovic Doc. Dr. Snežana Jovanović
	5	15.10.	15:40-19:00			Redox reactions.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		17.10.	08:00-14:00			Redox reactions.	doc. Dr. Andriana M. Bukonjic doc. Dr. Dusan Lj. Tomovic Doc. Dr. Snežana Jovanović
	6	22.10.	15:40-19:00			Qualitative chemical analysis.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		24.10.	08:00-14:00			Confirmatory tests of cations of the first and second groups.	doc. Dr. Andriana M. Bukonjic doc. Dr. Dusan Lj. Tomovic Doc. Dr. Snežana Jovanović
	7	29.10.	15:40-19:00			Cation and anion analysis.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		31.10.	08:00-14:00			Confirmatory tests of cations of the third, fourth and fifth groups. Confirmatory tests of anions.	doc. Dr. Andriana M. Bukonjic doc. Dr. Dusan Lj. Tomovic Doc. Dr. Snežana Jovanović

## TEACHING SCHEDULE FOR THE COURSE ANALYTICAL CHEMISTRY

module	week	date	time	place	type	the name of the method unit	teacher
		<b>04.11.</b>	<b>08:00-09:00</b>			<b>Final test of the first module</b>	
<b>2</b>	<b>8</b>	<b>05.11.</b>	<b>15:40-19:00</b>			Quantitative chemical analysis. Volumetric methods of analysis.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		<b>07.11.</b>	<b>08:00-14:00</b>			Preparation of standard solution. Calculations.	Prof. dr. Marija D. Živković Ana S. Živanović Doc. Dr. Snežana Jovanović
	<b>9</b>	<b>12.11.</b>	<b>15:40-19:00</b>			Calculations in volumetry.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		<b>14.11.</b>	<b>08:00-14:00</b>			Calculations in volumetry.	Prof. dr. Marija D. Živković Ana S. Živanović Doc. Dr. Snežana Jovanović
	<b>10</b>	<b>19.11.</b>	<b>15:40-19:00</b>			Acidimetry and alkalimetry.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		<b>21.11.</b>	<b>08:00-14:00</b>			Acid-base titrations.	Prof. dr. Marija D. Živković Ana S. Živanović Doc. Dr. Snežana Jovanović
	<b>11</b>	<b>26.11.</b>	<b>15:40-19:00</b>			Complexometry.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		<b>28.11.</b>	<b>08:00-14:00</b>			Complexometric titrations.	Prof. dr. Marija D. Živković Ana S. Živanović Doc. Dr. Snežana Jovanović
	<b>12</b>	<b>03.12.</b>	<b>15:40-19:00</b>			Precipitation titrations.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		<b>05.12.</b>	<b>08:00-14:00</b>			Precipitation titrations.	Prof. dr. Marija D. Živković Ana S. Živanović Doc. Dr. Snežana Jovanović
	<b>13</b>	<b>10.12.</b>	<b>15:40-19:00</b>			Oxidimetry and reductometry.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		<b>12.12.</b>	<b>08:00-14:00</b>			Oxidimetry and reductometry.	Prof. dr. Marija D. Živković Ana S. Živanović Doc. Dr. Snežana Jovanović

## TEACHING SCHEDULE FOR THE COURSE ANALYTICAL CHEMISTRY

module	week	date	time	place	type	the name of the method unit	teacher
	14	17.12.	15:40-19:00			Application of redox titration.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		19.12.	08:00-14:00			Redox titrations.	Prof. dr. Marija D. Živković Ana S. Živanović Doc. Dr. Snežana Jovanović
	15	24.12.	15:40-19:00			Gravimetric methods of analysis.	Prof. dr. Marija D. Živković Doc. Dr. Snežana Jovanović
		26.12.	08:00-14:00			Some examples of gravimetric determinations. Calculations in gravimetry.	Prof. dr. Marija D. Živković Ana S. Živanović Doc. Dr. Snežana Jovanović
		16.01.	08:00-09:00			<b>Final test of the second module</b>	
		06.02.	13:00-15:00			<b>Final exam</b>	