

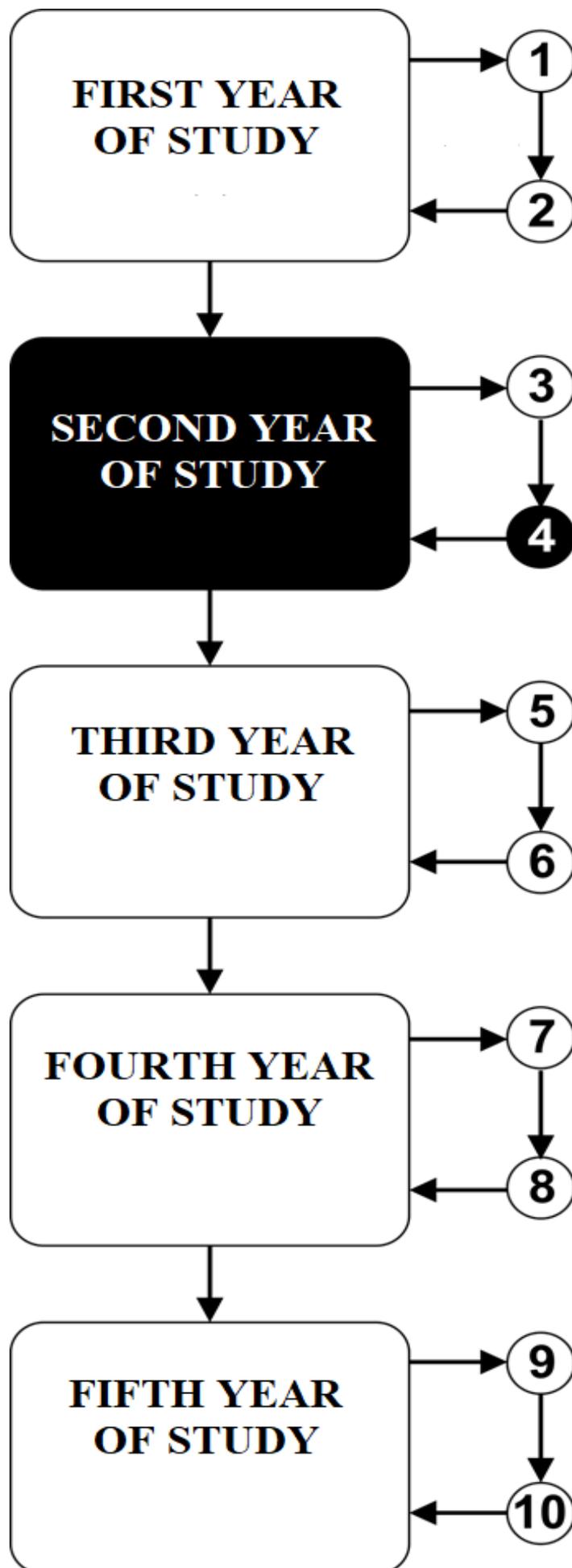


Pharmacy - Integrated academic studies

SECOND YEAR- Semester IV

2025/2026.

METHODS OF INSTRUMENTAL ANALYSIS



Subject:

METHODS OF INSTRUMENTAL ANALYSIS

The course is evaluated with 5 ECTS. There are 4 hours of active classes per week (2 hours of lectures and 2 hours of practice)

TEACHERS AND ASSOCIATES:

	Name and surname	E-mail address	Academic rank
1.	Nedeljko Manojlović	mtnedeljko@yahoo.com	Full professor
2.	Jovica Tomović	jovicatomovic2011@gmail.com	Assistant professor
3.	Aleksandar Kočović	salekkg91@gmail.com	Assistant professor

Course structure:

Module	Name of the module	Weeks	Lectures	Practice	Module Coordinator
1	Principles and division of instrumental methods. Atomic absorption spectrophotometry, flame photometry, refractometry, polarimetry and colorimetry. Electrochemical methods. Potentiometry. pH-metry. Analysis of secondary metabolites.	5	2	2	Full prof. Nedeljko Manojlović
2	Instrumental chromatographic methods of analysis. Gas and liquid chromatography. Combined methods. NMR spectroscopy.	5	2	2	Full prof. Nedeljko Manojlović
3	UV-VIS and IR spectroscopy. Mass spectrometry. Solving spectral problems (UV-VIS and IR spectroscopy, NMR and MS).	5	2	2	Full prof. Nedeljko Manojlović
					Σ 30+30=60

Students' knowledge assessment:

The student masters the subject in modules. The grade is equivalent to the number of points earned (see tables). Points are earned in two ways:

EXAM PREREQUISITES: A student can earn a total of 30 points from three areas. A minimum of 16 points is required for a student to pass the prerequisites.

FINAL EXAM: A student can earn a maximum of 70 points in the final exam, which covers the entire course material (lectures, exercises, and spectral problems).

MODULE		MAXIMUM POINTS		
		Exam prerequisites	Exam	Σ
1	Principles and division of instrumental methods. Atomic absorption spectrophotometry, flame photometry, refractometry, polarimetry and colorimetry. Electrochemical methods. Potentiometry. pH-metry. Analysis of secondary metabolites.	10	70	100
2	Instrumental chromatographic methods of analysis. Gas and liquid chromatography. Combined methods. NMR spectroscopy.	10		
3	UV-VIS and IR spectroscopy. Mass spectrometry. Solving spectral problems (UV-VIS and IR spectroscopy, NMR and MS).	10		
Σ		30	70	100

The final grade is formed as follows:

In order to pass the course, the student must obtain a minimum of 51 points. The final grade is formed on the basis of the number of points that can be gained on the following ways:

1. Pre-exam activities - Pre-exam activities are assessed through testing of exercises and knowledge of the area covered by the material. In each of the pre-exam activities, the student must achieve more than 50 percent.
2. Final exam - The student must achieve more than 50 percent (36 points) of the maximum 70 points. The final exam includes a knowledge check from the overall material covered during the class. It can also include solving spectral problems.

Num. achieved points	Num. grade	Definition
0 – 50	5	UNSATISFACTORY
51 – 60	6	PASS
61 – 70	7	SATISFACTORY
71 – 80	8	GOOD
81 – 90	9	VERY GOOD
91 – 100	10	EXCELLENT

LITERATURE:

Textbook	Authors	Publisher	Availability in the library
Pharmaceutical analysis: a textbook for pharmacy students and pharmaceutical chemists.	Watson DG.	Elsevier Health Sciences; 2015.	YES
Handbook of modern pharmaceutical analysis (Vol. 10).	Ahuja S. and Scypinski S.	Academic press; 2010.	YES
Pharmaceutical Analysis.	Lee D.	Oxford:Blackwell Scientific Publications. 2003.	YES
Ultraviolet and visible spectroscopy.	Thomas M.	New Jersey: John Wiley and Sons. 1996.	YES
Atkins' Physical Chemistry, 11th Edition.	Atkins P, de Paula J, and Keeler J.	Oxford University Press. 2017.	YES

All lectures (powerpoint presentations) are available on the website of the Faculty of Medical science: www.medf.kg.ac.rs

PROGRAM

FIRST MODULE: PRINCIPLES AND DIVISION OF INSTRUMENTAL METHODS. ATOMIC ABSORPTION SPECTROPHOTOMETRY, FLAME PHOTOMETRY, REFRACTOMETRY, POLARIMETRY AND COLORIMETRY. ELECTROCHEMICAL METHODS. POTENTIOMETRY. pH-METRY. ANALYSIS OF SECONDARY METABOLITES.

UNIT I (FIRST WEEK):

Lectures (2 classes)	Practice (2 classes)
Principles and types of instrumental methods. Electromagnetic radiation.	Methods for determining the qualitative and quantitative composition of pharmaceutical substances. Application of the Lambert-Beer law.

UNIT II (SECOND WEEK):

Lectures (2 classes)	Practice (2 classes)
Qualitative and quantitative analysis. Lambert-Beer law.	Application of the Lambert-Beer law.

UNIT III (THIRD WEEK):

Lectures (2 classes)	Practice (2 classes)
Basics of refractometry, polarimetry and colorimetry.	Measurement on a refractometer, polarimeter and colorimeter.

UNIT IV (FOURTH WEEK):

Lectures (2 classes)	Practice (2 classes)
Electrochemical methods.	Measurement on a pH-meter. Emission and absorption methods. Atomic absorption spectrophotometry (AAS). Flame photometric analysis.

UNIT V (FIFTH WEEK):

Lectures (2 classes)	Practice (2 classes)
Analysis of natural products.	Methods of analysis of natural products.

**INSTRUMENTAL CHROMATOGRAPHIC METHODS OF ANALYSIS. GAS
AND LIQUID CHROMATOGRAPHY. COMBINED METHODS. NMR
SPECTROSCOPY.**

UNIT VI (SIXTH WEEK):

Lectures (2 classes)	Practice (2 classes)
Instrumental chromatographic methods. Gas chromatography	Quantitative gas chromatographic analysis.

UNIT VII (SEVENTH WEEK):

Lectures (2 classes)	Practice (2 classes)
High Performance Liquid Chromatography-HPLC.	HPLC instrument

UNIT VIII (EIGHT WEEK):

Lectures (2 classes)	Practice (2 classes)
Combined chromatographic spectroscopic methods.	Application of combined methods.

UNIT IX (NINTH WEEK):

Lectures (2 classes)	Practice (2 classes)
Basics of NMR spectroscopy. ^1H NMR spectra.	Analysis of NMR spectra.

UNIT X (TENTH WEEK):

Lectures (2 classes)	Practice (2 classes)
^{13}C NMR and two-dimensional NMR spectroscopy.	Analysis of ^{13}C NMR spectra.

THIRD MODULE: UV-VIS AND IR SPECTROSCOPY. MASS SPECTROMETRY.

UNIT XI (ELEVENTH WEEK):

Lectures (2 classes)	Practice (2 classes)
Basics of UV-VIS spectroscopy. UV-VIS spectra. Quantitative UV-VIS analysis.	Calculation of absorption maximum (λ_{\max}). Calibration curve.

UNIT XII (TWELFTH WEEK):

Lectures (2 classes)	Practice (2 classes)
Basics of IR spectroscopy. IR spectra.	Analysis of IR spectra.

UNIT XIII (THIRTEENTH WEEK):

Lectures (2 classes)	Practice (2 classes)
IR spectra of compounds with C=O group. Recording of IR spectra.	Analysis of IR spectra with carbonyl group and recording of spectra.

UNIT XIV (FOURTEENTH WEEK):

Lectures (2 classes)	Practice (2 classes)
Basics of mass spectrometry. Mass spectra. Analysis of mass spectra.	Fragmentation of molecules and analysis of mass spectra.

UNIT XV (FIFTEENTH WEEK):

Lectures (2 classes)	Practice (2 classes)
Solving spectral problems using chromatographic and instrumental methods (UV-VIS and IR spectroscopy, NMR and MS).	Solving spectral problems.

LECTURES AND PRACTICE

MONDAY

BLUE HALL (H44)

12.05-15.05

[Schedule of lectures, practical classes and tests – academic calendar](#)

LESSON SCHEDULE FOR THE COURSE METHODS OF INSTRUMENTAL ANALYSIS

module	week	form	course unit title	teacher
1	1	L	Principles and types of instrumental methods. Electromagnetic radiation.	Prof. Dr. Nedeljko Manojlović
		P	Methods for determining the qualitative and quantitative composition of pharmaceutical substances.	Prof. Dr. Nedeljko Manojlović
	2	L	Qualitative and quantitative analysis. Lambert-Beer law.	Prof. Dr. Nedeljko Manojlović
		P	Application of the Lambert-Beer law.	Prof. Dr. Nedeljko Manojlović
	3	L	Basics of refractometry, polarimetry and colorimetry.	Prof. Dr. Nedeljko Manojlović
		P	Measurement on a refractometer, polarimeter and colorimeter.	Asst. prof. Jovica Tomović Asst. prof. Aleksandar Kočović
	4	L	Electrochemical methods.	Prof. Dr. Nedeljko Manojlović
		P	Measurement on a pH-meter. Emission and absorption methods. Atomic absorption spectrophotometry (AAS). Flame photometric analysis	Asst. prof. Jovica Tomović Asst. prof. Aleksandar Kočović
	5	L	Analysis of natural products.	Prof. Dr. Nedeljko Manojlović
		P	Methods of analysis of natural products.	Prof. Dr. Nedeljko Manojlović
2	6	L	Instrumental chromatographic methods. Gas chromatography	Prof. Dr. Nedeljko Manojlović
		P	Quantitative gas chromatographic analysis.	Prof. Dr. Nedeljko Manojlović
2	7	L	High Performance Liquid Chromatography-HPLC.	Prof. Dr. Nedeljko Manojlović

LESSON SCHEDULE FOR THE COURSE METHODS OF INSTRUMENTAL ANALYSIS

module	week	form	course unit title	teacher	
	8	P	HPLC instrument	Prof. Dr. Nedeljko Manojlović	
		L	Combined chromatographic spectroscopic methods.	Prof. Dr. Nedeljko Manojlović	
		P	Application of combined methods.	Prof. Dr. Nedeljko Manojlović	
	9	L	Basics of NMR spectroscopy. ¹ H NMR spectra.	Prof. Dr. Nedeljko Manojlović	
		P	Analysis of NMR spectra.	Prof. Dr. Nedeljko Manojlović	
	10	L	¹³ C NMR and two-dimensional NMR spectroscopy.	Prof. Dr. Nedeljko Manojlović	
		P	Analysis of ¹³ C NMR spectra.	Prof. Dr. Nedeljko Manojlović	
	3	11	L	Basics of UV-VIS spectroscopy. UV-VIS spectra. Quantitative UV-VIS analysis.	Prof. Dr. Nedeljko Manojlović
			P	Calculation of absorption maximum (λ_{max}). Calibration curve.	Asst. Prof. Jovica Tomović Asst. Prof. Aleksandar Kočović
	3	12	L	Basics of IR spectroscopy. IR spectra.	Prof. Dr. Nedeljko Manojlović
P			Analysis of IR spectra.	Prof. Dr. Nedeljko Manojlović	
13		L	IR spectra of compounds with C=O group. Recording of IR spectra.	Prof. Dr. Nedeljko Manojlović	
		P	Analysis of IR spectra with carbonyl group and recording of spectra.	Prof. Dr. Nedeljko Manojlović	
14		L	Basics of mass spectrometry. Mass spectra. Analysis of mass spectra.	Prof. Dr. Nedeljko Manojlović	
		P	Fragmentation of molecules and analysis of mass spectra.	Prof. Dr. Nedeljko Manojlović	

LESSON SCHEDULE FOR THE COURSE METHODS OF INSTRUMENTAL ANALYSIS

module	week	form	course unit title	teacher
	15	L	Solving spectral problems using chromatographic and instrumental methods (UV-VIS and IR spectroscopy, NMR and MS).	Prof. Dr. Nedeljko Manojlović
		P	Solving spectral problems.	Prof. Dr. Nedeljko Manojlović
			TEST	
			EXAM	