

COURSE GUIDE – EXTENDED FORM

Academic year 2026 – 2027

1. Program information

1.1 University	"Gheorghe Asachi" Technical University of Iasi
1.2 Faculty	"Cristofor Simionescu" Faculty of Chemical Engineering and Environmental Protection
1.3 Department	Organic, Biochemical and Food Engineering
1.4 Field	Chemical Engineering
1.5 Study level	Master
1.6 Specialization	Chemical and Biochemical Process Technology - CBPT

2. Course information

2.1.1 Course name	Instrumental analysis of molecules						
2.1.2 Course code	504	2.1.3. Course category Fundamental/Specialized/Complementary)			DF		
2.2 Course instructor	Professor Adrian Ungureanu						
2.3 Course instructors for applied activities (S, L, P, Pr)	Professor Adrian Ungureanu						
2.4 Year of study ²	1	2.5 Semester I ³	1	2.6 Evaluation type ⁴	E	2.7 Course type ⁵	DOB

3. Amount of time estimated for course activities (hours / term)

3.1 Hours /week	4	3.2 course	2	3.3a sem.	0	3.3b laboratory	2	3.3c project	0	3.3.d. practice	0
3.4 Total hours from curriculum ⁶	56	3.5 course	28	3.6a sem.	0	3.6b laboratory	28	3.6c project	0		
Time spent for related activities ⁷										Hours	
Study of recommended books, course support, scientific papers and course notes										30	
Study in library and practical skills development										26	
Preparation of seminars / laboratory works / project phases / home works / presentations										20	
Evaluation ⁸										3	
Other activities:											
3.7 Total hours of individual study ⁹	76										
3.8 Total hours per semestre ¹⁰	135										
3.9 Number of credits	5										

4. Prerequisites (optional)

4.1 curriculum ¹¹	-
4.2 learning outcomes	-

5. Requirements

5.1 Conditions for course delivery ¹²	Whiteboard, video projector, specific materials will be used. Students must attend the course with their mobile phones turned off.
5.2 Laboratory requirements ¹³	Students must enter the laboratory with their mobile phones turned off. During laboratory work, students must wear lab coats and protective equipment appropriate for handling microorganisms. Students must come to the laboratory with written reports on the experiments to be carried out, already studied and understood. Students are not allowed to leave operating equipment unattended. Bringing food into the laboratory is strictly prohibited. Attendance at laboratory sessions is mandatory. Any accident or incident must be reported immediately to the lab supervisor. Unauthorized handling of microorganisms and equipment is strictly forbidden.

6. Overall objective of the course

In this course, methods for the characterization and testing of organic and macromolecular compounds will be presented, including: emission spectroscopy (fluorescence, bio- and chemiluminescence); chromatographic methods such as HPLC, GPC, HPSEC, gas chromatography, and coupled or tandem chromatographic techniques (GC-MS, HPLC-MS) for the analysis of chemical

systems. By completing the course and its applications, students will acquire skills to understand the theoretical aspects and apply them in practical situations as well as the ability to develop viable solutions within the field of chemical and biochemical engineering.

7. Learning outcomes

Knowledge	<p>The student / graduate:</p> <ul style="list-style-type: none"> - explains the fundamental principles of molecular spectrometry, including absorption, vibration, emission, and luminescence phenomena. - describes the interaction between electromagnetic radiation and matter, and the basic components and operation of spectrometers. - applies spectroscopic methods (fluorescence, bio- and chemiluminescence) for the identification and quantitative analysis of organic compounds and biomolecules. - compares and understands liquid chromatographic systems (HPLC, HPSEC, GPC), identifying their main components and functions. - explains the principles and operation of GC, including detector and column selection based on analytical requirements; interprets chromatographic data and assess theoretical aspects of separation mechanisms in liquid chromatography. - uses appropriate analytical methods for the characterization and quantitative analysis of biomolecules.
Skills	<p>The student / graduate:</p> <ul style="list-style-type: none"> - uses appropriate analytical methods for the characterization and quantitative analysis of biomolecules. - analyse the consistency of experimental data using simple models. - operates specific spectroscopic and chromatographic systems. - critically evaluates different instrumental methods and propose viable analytical solutions in the field of chemical and biochemical engineering.
Responsibility and autonomy	<p>The student / graduate:</p> <ul style="list-style-type: none"> - respects ethical principles, standards, and values in the correct and timely completion of professional tasks, by adopting a rigorous, efficient, and responsible work strategy in decision-making and problem-solving; - assumes responsibility for contributing to professional knowledge and practices and/or for reviewing the strategic performance of teams; - engages in continuous professional development in their field by appropriately using effective lifelong learning methods and techniques.

8. Teaching methods

The teaching process will involve participatory lectures and debates, supported by PowerPoint presentations made available to students. These presentations include images and diagrams to make the information easier to understand and assimilate. Each lecture will begin with a brief review of the topics covered in the previous session.

The teaching method is also based on discovery learning models, facilitated through both direct and indirect exploration of reality (e.g., experiments, demonstrations, modelling). Additionally, action-based methods will be employed, such as practical exercises, hands-on activities, and problem-solving tasks.

9. Course content

9. 1. Courses ¹⁵	Teaching methods	Time allocation
9.1.1. Absorption, vibration and emission molecular spectrometry. Elementary notions. Electromagnetic radiation- matter interaction. Luminescence. Basic elements of spectrometers. Applications of use in biomolecules identification and quantitative analysis.	Interactive lecture Guided discussions Clarifying explanations	8 hours
9.1.2. Liquid chromatography in biomolecules characterization: Fundamentals of liquid chromatography, types of liquid chromatography (HPLC, HPSEC, GPC). Description of the components of HPLC systems, role and importance. Data processing - theoretical aspects.		12 hours
9.1.3 Gas chromatography –Fundamentals of separation, methods of operation and detection. Principles for working conditions, column and detector selection.		4 hours
9.1.4 Principles in design and choosing of analytical methods for analysis of biomolecules.		4 hours
Course bibliography: <ol style="list-style-type: none"> 1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Principles of Instrumental Analysis (Chapters 13, 14 and 27), Seventh Edition, Published by Cengage Learning, 2017. 2. C. N. Banwell, Elaine M. McCash Fundamentals of Molecular Spectroscopy, McGraw-Hill, 1994 		

3. Champiat, J.-P. Larpent, <i>Bio-chimi-luminescence. Principes et applications</i> . Masson, Pris, Milan, Barcelone, Bonn, 1993		
4. R. Olinescu, Maria Greabu, <i>Chemiluminescență și bioluminescență</i> , Ed. Tehnică, București, 1987		
5. Yuegang Zuo, PhD (Editor), <i>High-Performance Liquid Chromatography (HPLC): Principles, Practices and Procedures</i> Dartmouth, North Dartmouth, MA, USA		
6. I. Pogany, M. Banciu, <i>Tehnica experimentală in chimia organica</i> , Ed. Stiintifica si Enciclopedica, Bucuresti, 1977		
7. L. Roman, R. Săndulescu, <i>Chimie analitică. Vol. III. Metode de separare și analiză instrumentală</i> , Ed. Did. & Ped. 1999		
8. K. W. Hutchenson, N. Foster, <i>Innovations in supercritical fluids. Science and Technology</i> , ACS Symposium Series, Washington, DC, 1995		
9.2b Laboratory	Working methods ¹⁷	Observations, Time allocation
9.2.1 Absorption and emission molecular spectrometry. UV-VIS and fluorescence spectroscopy. Spectra recording of quinine and fluoresceine solution. Quantitative determination	Practical demonstrations, exercises, experiments	4 hours
9.2.2 FT-IR spectroscopy. Fundamentals and practical approach in recording and data processing		4 hours
9.2.3 Liquid chromatography –HPLC principles. System description. Practical approach in chromatographic separation – establishing retention time methods;		4 hours
9.2.4 Liquid chromatography –HPLC practical approach in system calibration and quantitative determination of biomolecules		4 hours
9.2.5 HPSEC and GPC chromatography applications for biomacromolecules characterization		4 hours
9.2.6 Applications of gas-chromatography in biomolecules separation and determination		4 hours
9.2.7 Comparative assessment and evaluation of studied techniques as prerequisite in establishing analytical protocols. Student evaluation.		4 hours
Bibliography for applied activities (seminar / laboratory / project):		
1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, <i>Principles of Instrumental Analysis</i> (Chapters 13, 14 and 27), Seventh Edition, Published by Cengage Learning, 2017.		
2. C. N. Banwell, Elaine M. McCash <i>Fundamentals of Molecular Spectroscopy</i> , McGraw-Hill, 1994		
3. Yuegang Zuo, PhD (Editor), <i>High-Performance Liquid Chromatography (HPLC): Principles, Practices and Procedures</i> Dartmouth, North Dartmouth, MA, USA		
4. Agilent Technologies, <i>Fundamentals of Gas Chromatography</i> , First Edition, 2002.		
5. Valtcho D. Zheljzkov, Charles L. Cantrell, Tess Astatkie, Ekaterina Jeliaskova, Distillation Time Effect on Lavander Essential Oil Yield and Composition, <i>Journal of Oleo Science</i> , 62, 2013, pp. 195-199.		
6. Adrian Ungureanu, <i>Cataliză și materiale catalitice. Lucrări practice de laborator</i> (format electronic), 2015.		
7. Hawaa S. Elferjani, Najw H. S. Ahmida, Aziza Ahmida, Determination of Hydroquinone in Some Pharmaceutical and Cosmetic Preparations by Spectrophotometric Method, <i>International Journal of Science and Research</i> , 6, 2017, pp. 2219-2224.		
8. Mettler Toledo, UV-Vis Application Note M9113, Hydroquinone in Cosmetics (https://www.mt.com)		

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation method		10.3 Percentage of the final grade (recommended to be proportional to the number of hours allocated to each type of activity)
10.4 Type of evaluation: Final Exam / Assessment	<i>Completeness and correctness of knowledge. Logical coherence, fluency, strength of argumentation. Capacity for analysis, personal interpretation, originality, creativity. Degree of mastery of specialized terminology and communication skills. Ability to apply acquired skills.</i>	<i>Systematic observation of students (individual/team assignments – assignments must be completed during the week between lectures, preparation of a report – case study).</i>	20 %	60%
		<i>Formative assessment test (ongoing evaluations throughout the semester).</i>	40 %	

	<i>Ability to process data and solve given problems.</i>	<i>Summative assessment test (final evaluation).</i>	<i>40 %</i>
10.5b Laboratory	<i>Laboratory activity – Ability to work in a team, ability to apply learned knowledge in practice, in different contexts. Capacity for analysis, personal interpretation, originality, and creativity.</i>	<i>Completion of laboratory sheets (all lab works must be completed, allowing the makeup of only one missed lab work); Assessment test (laboratory colloquium).</i>	40%
10.6 Conditions for passing			
The final evaluation result for a course is determined by considering the scores and weights assigned to each activity within the course. Whole-number grades from 10 to 1 will be awarded, with a grade of 5 certifying the achievement of the minimal learning outcomes required for the course and the awarding of the corresponding study credits.			

Date: 01.09.2025

Course instructor: Professor Adrian Ungureanu

Course instructors for applied activities: Professor Adrian Ungureanu

Date of approval by the department: 5.09.2025

Head of Department
Associate professor Corina Cernatescu

Date of approval by the Faculty Council: 8.09.2025

Dean,

Professor Teodor Malutan

¹ Bachelor's / Master's degree.

² For Bachelor's: 1-4; for Master's: 1-2.

³ For Bachelor's: 1-8; for Master's: 1-4.

⁴ Exam (E), assessment (A) – according to the curriculum.

⁵ DOB – mandatory course, DOP – optional course, DFA – elective course;

⁶ Duration equals 14 weeks multiplied by the number of hours listed at point 3.1 (similarly for points 3.5 and 3.6abc).

⁷ The lines below refer to individual study; total is completed at point 3.7.

⁸ Between 2 and 6 teaching hours, not included in individual study.

⁹ Total number of individual study hours (sum of values from previous lines).

¹⁰ Total of direct teaching hours (3.4) plus individual study hours (3.7); must equal the number of credits (3.9) multiplied by 27 hours per credit.

¹¹ Prerequisite courses that must be passed previously or their equivalents are indicated.

¹² Teaching resources: blackboard, video projector, flipchart, specific teaching materials, etc.

¹³ Technical equipment: computers, software packages, experimental stands, etc

¹⁴ Learning outcomes presented as knowledge, skills, responsibility, and autonomy specific to the course, aligned with level 7 of the National Qualifications Framework (NQF) and adapted to the type of university program. For research master's programs, these include competences necessary for conducting independent scientific research (<https://www.aracis.ro/wp-content/uploads/2025/07/Standard-specifice-masterat.pdf>).

¹⁵ Titles of chapters and paragraphs.

¹⁶ Teaching methods: discussions, debates, presentations and/or paper analyses, exercises and problem solving.

¹⁷ Practical demonstrations, exercises, experiments.

¹⁸ Case studies, demonstrations, exercises, error analysis, etc.