

SYLLABUS

1. Information about the program

1.1 Higher education institution	Politehnica University Timisoara
1.2 Faculty ¹ / Department ²	Chemical Engineering, Biotechnologies and Environmental Protection / CAICAM
1.3 Field of study (name/code ³)	Chemical Engineering / 10.30.50
1.4 Study cycle	License
1.5 Study program (name/code/qualification)	Chemical Engineering / 10.30.50.60 / engineer

2. Information about the discipline

2.1 Name of discipline/ formative category ⁴	Blue-green nature based solutions for circular wastewater treatment / DS						
2.2 Coordinator (holder) of course activities	Florica MANEA.						
2.3 Coordinator (holder) of applied activities ⁵	Florica MANEA						
2.4 Year of study ⁶	IV	2.5 Semester	8	2.6 Type of evaluation	E	2.7 Regime of discipline ⁷	DO

3. Total estimated time – hours / semester: direct teaching activities (fully assisted or partly assisted) and individual training activities (unassisted)⁸

3.1 Number of fully assisted hours / week	3.5 of which:	3.2 course	2	3.3 seminar / laboratory / project	0/1.5/0
3.1* Total number of fully assisted hours / semester	49 of which:	3.2* course	28	3.3* seminar / laboratory / project	0/21/0
3.4 Number of hours partially assisted / week	of which:	3.5 training		3.6 hours for diploma project elaboration	
3.4* Total number of hours partially assisted / semester	of which:	3.5* training		3.6* hours for diploma project elaboration	
3.7 Number of hours of unassisted activities / week	5.43 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			
		hours of individual study after manual, course support, bibliography and notes			
		training seminars / laboratories, homework and papers, portfolios and essays			
3.7* Number of hours of unassisted activities / semester	76 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			
		hours of individual study after manual, course support, bibliography and notes			
		training seminars / laboratories, homework and papers, portfolios and essays			
3.8 Total hours / week ⁹	8.93				
3.8* Total hours /semester	125				
3.9 Number of credits	5				

4. Prerequisites (where applicable)

4.1 Curriculum	<ul style="list-style-type: none"> Analytical Chemistry and Instrumental Analysis; Physical Chemistry; Transfer phenomena; Hydrodynamics; Principles of Chemical Engineering
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¹ The name of the faculty which manages the educational curriculum to which the discipline belongs

² The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.

³ The code provided in HG - on the approval of the Nomenclature of fields and specializations / study programs, annually updated.

⁴ Discipline falls under the educational curriculum in one of the following formative disciplines: Basic Discipline (DF), Domain Discipline (DD), Specialist Discipline (DS) or Complementary Discipline (DC).

⁵ Application activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).

⁶ Year of studies in which the discipline is provided in the curriculum.

⁷ Discipline may have one of the following regimes: imposed discipline (DI) or compulsory discipline (DOb)-for the other fundamental fields of studies offered by UPT, optional discipline (DO) or optional discipline (Df).

⁸ The number of hours in the headings 3.1 *, 3.2 *, ..., 3.8 * is obtained by multiplying by 14 (weeks) the number of hours in headings 3.1, 3.2, ..., 3.8. The information in sections 3.1, 3.4 and 3.7 is the verification keys used by ARACIS as: (3.1) + (3.4) ≥ 28 hours / wk. and (3.8) ≤ 40 hours / wk.

⁹ The total number of hours / week is obtained by summing up the number of hours in points 3.1, 3.4 and 3.7.

4.2 Competencies	<ul style="list-style-type: none"> • Description, analysis and use of fundamental concepts and theories in the field of chemistry, chemical engineering and the applications of tools for analysis and modern management of processes, including through digital systems •
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5. Conditions (where applicable)

5.1 of the course	<ul style="list-style-type: none"> • Medium or large class room, equipped with video projector and internet connection; online
5.2 to conduct practical activities	<ul style="list-style-type: none"> • Lab room; online

6. Specific competencies acquired through this discipline

Specific competencies	<ul style="list-style-type: none"> • Assessment of wastewater quality • Exploitation of municipal/industrial wastewater treatment plants • Identification of green solutions and their integration within existing or new treatment flow of wastewater including its recycling and reusing
Professional competencies ascribed to the specific competencies	<ul style="list-style-type: none"> • - Analyse production processes for improvement; • - Manage chemical testing procedures; • - Test materials; • - Write technical reports • -Performs chemical experiments • -Approve engineering design • -Assess environmental impact
Transversal competencies ascribed to the specific competencies	<ul style="list-style-type: none"> • - Conduct quality control; • - Apply scientific, technological and engineering knowledge; • - Uses equipment, instruments or technological equipment accurately.

7. Objectives of the discipline (based on the grid of specific competencies acquired - pct.6)

7.1 The general objective of the discipline	<ul style="list-style-type: none"> • To assure the competencies and skills to understand environmental oriented issues related to anthropic activities especially chemical engineering, which generates the wastewaters, and technological aspects to prevent and mitigate their environmental impact within the context of the sustainability and the circular economy
7.2 Specific objectives	<ul style="list-style-type: none"> • Evaluation of the impact of anthropic activities on environmental factors; • Legislation and quality characteristics of municipal wastewater/residual effluents; • Identification/selection of the conventional/innovative unitary processes in the technological solution for the treatment of wastewater/residual effluents; • Integrating the concept of circular economy in the field of wastewater; • Evaluation of the proposed technology solutions

8. Content ¹⁰

8.1 Course	Number of hours	Teaching methods ¹¹
I.Introduction. Terminology and definitions. Wastewater classification and quality.	2	•powerpoint and/or blackboard, conversation and debate,

¹⁰ It details all the didactic activities foreseen in the curriculum (lectures and seminar themes, the list of laboratory works, the content of the stages of project preparation, the theme of each practice stage). The titles of the laboratory work carried out on the stands shall be accompanied by the notation "(*)".

¹¹ Presentation of the teaching methods will include the use of new technologies (e-mail, personalized web page, electronic resources etc.).

II. Policy and law regulations related to municipal/industrial wastewater and rainwater treatment. EU vs RO legislation. Water circularity; Water-energy nexus; Water-related sustainable development goals	2	exemplifying, problematization, case studies., video
III. Industrial/municipal wastewater treatment within the context of the circular economy. Case studies	4	
IV.1 Conventional wastewater treatment solutions. Separation unitary processes	2	
IV.2 Conventional wastewater treatment solutions. Degradation unitary processes	4	
V. Advanced processes for wastewater treatment	4	
VI. Nature-based solutions (NBSs) for wastewater treatment. Factsheets and case studies	4	
VII. Integration of NBSs within conventional wastewater treatment	4	
VIII. Sludge management	2	

Bibliography ¹²

1. ***Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment;
2. ***Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse;
- 3.*** The European Green Deal - European Commission (europa.eu);
4. Morsetto, P., Mooren, C.E. & Munaretto, S. Circular Economy of Water: Definition, Strategies and Challenges. Circular Economy and Sustainability 2, 1463–1477 (2022). <https://doi.org/10.1007/s43615-022-00165-x>;
5. *** Best available techniques (BAT) Reference document for Common Gas Management and Treatment System in the Chemical Sector, Joint research Centre, European IPPC Bureau, 2019;
6. Manea F., Pop A., Decontamination of wastewater containing organics by electrochemical methods in : Water Treatment (Eds: W. Elshorbagy), Intech 2013;
7. Racoviteanu, G. Teoria decantarii si filtrarii apei, Ed. Matrix Rom Bucuresti, 2003;
8. Hocking M.B., Handbook of Chemical Technology and Pollution Control, Ed. Academic Press Toronto, 1998;
9. Vasilie S., Manea F., Baciu A., Pop A., Dual use of boron-doped diamond electrode in antibiotics-containing water treatment and process control, Process Safety and Environmental Protection 117, 2018, p.446;
10. Baciu, A., Negrea, S., Manea, F., Electrocatalytic degradation of organic pollutants from water, in Photocatalysts and Electrocatalysts in Water Remediation: From Fundamentals to Full Scale Applications (Eds. P.Bhunia, K. Dutta, S. Vadivel), Ed. John Wiley & Sons Ltd, 2023;
11. Tilley, E., Ulrich, L., Lüthi, C., Reymond, Ph., Schertenleib R. and Zurbrügg, C., Compendium of Sanitation Systems and Technologies. 2nd Revised Edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG). Dübendorf, Switzerland, 2014;
12. Cross, K., Tondera, K.; Rizzo, A.; Andrews, L.; Pucher, B.; Istenič, D.; Karres, N; McDonald, R., Nature-Based Solutions for Wastewater Treatment: A Series of Factsheets and Case Studies, IWA Publishing, 2021;
13. Rath, S.; Mohapatra, B., Blue-green nature-based solutions for urban wastewater - enabling a circular economy, INCD URBAN-INCERC 14 (2), p.147.

8.2 Applied activities ¹³	Number of hours	Teaching methods
1.Assessment of wastewater and rainwater quality.	4	Experimental studies/problematization/discussion; conclusions for each experimental study
2. Slow-rate soil infiltration system for rainwater and wastewater treatment.	4	
3.Functional and operational parameters of automated filtering system for wastewater treatment. Multilayer filtering system for wastewater treatment.	4	
4.Comparative study for applying coagulation and electrocoagulation in industrial wastewater treatment.	4	
5.Coagulation-slow-rate infiltration coupled system for advanced wastewater treatment.	4	
6.Experimental data interpretation. Report elaboration.	1	

¹² At least one title must belong to the discipline team and at least one title should refer to a reference work for discipline, national and international circulation, existing in the UPT library.

¹³ Types of application activities are those specified in footnote 5. If the discipline contains several types of applicative activities then they are sequentially in the lines of the table below. The type of activity will be in a distinct line as: "Seminar:", "Laboratory:", "Project:" and / or "Practice/training".

Bibliography ¹⁴		
1. ***Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment;		
2. ***Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse;		
3.*** The European Green Deal - European Commission (europa.eu);		
4. Manea F., Pop A., Decontamination of Wastewater Containing Organics by Electrochemical Methods in: Water Treatment (Eds: W. Elshorbagy), Intech 2013;		
5. Vasilie S., Manea F., Baciu A., Pop A., Dual Use of Boron-doped Diamond Electrode in Antibiotics-Containing Water Treatment and Process Control, Process Safety and Environmental Protection 117, 2018, p. 446		
6. Baciu, A., Negrea, S., Manea, F., Electrocatalytic Degradation of Organic Pollutants from Water, in Photocatalysts and Electrocatalysts in Water Remediation: From Fundamentals to Full Scale Applications (Eds. P.Bhunia, K. Dutta, S. Vadivel), Ed. John Wiley & Sons Ltd, 2023		
7.Cross, K., Tondera, K., Rizzo, A., Andrews, L., Pucher, B.,Istenič, D., Karres, N., McDonald, R., Nature-Based Solutions for Wastewater Treatment: A Series of Factsheets and Case Studies, IWA Publishing, 2021		
8. Baciu, A., Orha, C., Nicolae, R., Nicolaescu, M., Ilies, S., Manea, F. Advanced Electrochemical Degradation of Organic Pollutants from Water Using Sb-Doped SnO ₂ /Ti Anode and Assisted by Granular Activated Carbon. Coatings 2023, 13, p.1127. https://doi.org/10.3390/coatings13061127		
9. Vasilie, S., Vitan, L.-D., Tudoran, C.-A., Manea, F. Flexible Electroflotocoagulation Reactor: New Design and Testing in Treatment of Real Surface Water. Water 2022, 14, p.2990. https://doi.org/10.3390/w14192990		

9. Corroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program

- The teaching staff serving the discipline is involved in numerous fundamental and applied research projects at national and international level, which involves the inclusion in consortia with industry and local authorities/regional water-sewage operators (SC.Beespeed Automatizari SRL; SC Datcomp SRL; SC Datronic SRL., SC Linde Gas-Water and wastewater treatment; Regional Environmental Protection Agency, SC Aquatim SA. Both the course and the laboratory were developed in such a way as to meet the current requirements regarding the existence of installations intended for testing unitary processes or their combination including nature-based solutions for the development of various technological solutions (blue-green) for wastewater and rainwater treatment .

10. Evaluation

Type of activity	10.1 Evaluation criteria ¹⁵	10.2 Evaluation methods	10.3 Share of the final grade
10.4 Course	Acquiring general informations regarding the concept of circular economy in wastewater treatment technology; mastering the main representative aspects regarding the quality of wastewater (quality parameters/indicators); mastering the aspects related to the principles of different unitary processes suitable for wastewater treatment technology	Examination by written and oral tests	66%
10.5 Applied activities	S:		
	L: The correct evaluation of the performance of a unitary process/technological solution for the treatment of wastewater considering also the process control parameters; the legislation and regulations regarding quality conditions	Oral evaluation by survey, at the beginning, during and at the end of each laboratory experiment.	34%
	P ¹⁶ :		

¹⁴ At least one title must belong to the discipline team.

¹⁵ Syllabus must contain the procedure for assessing the discipline, specifying the criteria, methods and forms of assessment, as well as specifying the weightings assigned to them in the final grade. The evaluation criteria shall be formulated separately for each activity foreseen in the curriculum (course, seminar, laboratory, project). They will also refer to the forms of verification (homework, papers, etc.)

¹⁶ In the case where the project is not a distinct discipline, this section also specifies how the outcome of the project evaluation makes the admission of the student conditional on the final assessment within the discipline.

	Pr:	
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified ¹⁷)		
<ul style="list-style-type: none"> The ability to identify the necessary elements to correctly select a technological solution for wastewater treatment related to its quality 		

Date of completion

**Course coordinator
(signature)**

Prof.dr.ing. Florica MANEA

**Coordinator of applied activities
(signature)**

Prof.dr.ing. Florica MANEA

**Head of Department
(signature)**

Conf.dr.ing. Andrea
KELLENBERGER

Date of approval in the Faculty Council ¹⁸

**Dean
(signature)**

Ş.L.dr.ing. Mircea Laurențiu DAN

¹⁷ It will not explain how the promotion mark is awarded.

¹⁸ The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.