COURSE SYLLABUS

1. Program information

1.1. Institution	Petroleum - Gas University of Ploiesti
1.2. Faculty	Petroleum Refining and Petrochemistry
1.3. Department	IPPPM
1.4. Field of study	Chemical Engineering
1.5.Study cycle	Master
1.6. Study program	Chemical Engineering for Refineries and Petrochemistry

2. Course information

2.1.Course title	**Petrochemicals and fine chemicals synthesis**
2.2. Course coordinator	Assist. Prof. Ph.D. Eng. Movileanu Daniela Luminița
2.3.Laboratory / seminar coordinator	Assist. Prof. Ph.D. Eng. Movileanu Daniela Luminița
2.4. Year of study	I
2.5. Semester *	2
2.6.Evaluation type	E
2.7. Course type - formative category **/ Type of subject matter ***	FC/MND

*the semester number is in accordance with the curriculum;

**fundamental = F0; domain = D1; speciality = S2; complementary = C3

***compulsory = C; optional = O; elective= E

3. Total estimated time (teaching hours per semester)

3.1. Number of hours per week	4	of which: 3.2. course	2	3.3.Seminar/laboratory	2	3.4.Project	-
3.5. Total hours from curriculum	56	of which: 3.6. course	28	3.7. Seminar/laboratory	28	3.8. Project	-

3.9. Total hours of individual study (Study of textbook, course support, bibliography, study of textbook, course support, further reading in the library, on online platforms, preparing seminars/laboratories, homework, portfolios and essays)	124
3.10. Total hours per semester	180
3.11. Number of credits	6

4. Prerequisites (where applicable)

4.1. Curriculum requirements	➢ graduated bachelor ➢ knowledge of organic chemistry, catalysis, mathematics, chemical reactors, use of computer technologies for data acquisition and processing and for documentation
4.2. Course requirements:	➢ Course room with video projector
4.3. Seminar/Laboratory requirements:	➢ Laboratory with micropilot plants

5. Specific competences acquired and learning achievements* outcomes

Professional competences	Learning achievements*
1. Develops and optimizes complex chemical processes	K1 - The student describes and correlates advanced models of chemical kinetics and applied thermodynamics. K2 - The student explains mechanisms of mass, heat, and momentum transfer in complex reactive systems. S2 - The student integrates experimental data with mathematical models for process optimization. LO1 - The student makes autonomous decisions regarding process efficiency, safety, and sustainability. LO2 - The student documents and presents results in technical-scientific reports.
2. Designs equipment and installations for the chemical industry	K1 - The student describes advanced principles of equipment sizing and operation. K2 - The student identifies modern technological solutions for process intensification. K3 - The student defines criteria for selecting materials and equipment depending on applications. S1- The student uses computer-aided design methods. S2 - The student develops technological schemes and mass and energy balances. LO1 - The student assumes responsibility for coordinating engineering projects. LO2 - The student collaborates effectively in multidisciplinary teams.
3. Integrates principles of sustainable development and circular economy	K1 - The student describes advanced concepts of sustainable development applicable in chemical engineering. K2 - The student identifies strategies for reducing, reusing, and valorizing resources. K3 - The student defines performance indicators for sustainable processes. S1 - The student evaluates the environmental impact of chemical processes. S2 - The student proposes technological solutions for pollution reduction and energy efficiency. LO1 - The student makes decisions in accordance with environmental legislation and sustainability principles. LO2 - The student promotes ethical conduct in resource use.
4.Uses advanced techniques of analysis and quality control	K1 - The student describes modern methods of instrumental analysis and material characterization. K2 - The student explains principles of validation and calibration of analytical methods. S1 - The student applies advanced experimental methods for product characterization. S2 - The student uses statistical tools for analytical data interpretation. LO1 - The student takes responsibility for validating and reporting results. LO2 - The student prepares quality reports according to international standards.
5.Carries out research and innovation activities in chemical engineering	K1 - The student describes advanced research methodologies in chemical engineering.

	K2 - The student identifies innovative directions for the development of processes and products. K3 - The student defines methods for experiment design and interpretation. S1 - The student applies experimental and computational methods to obtain original results. S2 - The student writes scientific papers and research projects. LO1 - The student demonstrates autonomy in carrying out research projects. LO2 - The student disseminates results nationally and internationally.
6.Leads and manages activities in the chemical industry	K1 - The student explains modern methods of process and project management. K2 - The student describes the legal framework and occupational health and safety standards. K3 - The student identifies mechanisms for project economic evaluation. S1 - The student applies management tools for coordinating resources and teams. S2 - The student uses economic and financial analysis methods for processes. LO1 - The student makes strategic decisions regarding project development and implementation. LO2 - The student demonstrates autonomy and leadership in coordinating multidisciplinary teams.
Transversal competences	**Learning achievements***
Develops critical thinking and the ability to solve complex problems	K1 - The student identifies reasoning models applicable in interdisciplinary contexts. S1 - The student applies methods of analysis and synthesis to solve complex problems. S2 - The student uses modern tools for decision evaluation and substantiation. LO1 - The student takes responsibility for the proposed solutions and their impact. LO2 - The student demonstrates autonomy in the critical approach of complex situations.
Communicates effectively orally and in writing in Romanian and in an international language	K1 - The student explains the specialized terminology in Romanian and in a foreign language. S1 - The student drafts reports, presentations, and professional documents. S2 - The student delivers oral presentations and debates in academic and professional contexts. LO1 - The student takes responsibility for the correct and clear transmission of information. LO2 - The student demonstrates autonomy in selecting means and communication strategies.
Collaborates effectively in multidisciplinary and intercultural teams	K1 - The student explains the dynamics and roles of members in a multidisciplinary team. S1 - The student actively participates in team activities and contributes to achieving common goals. S2 - The student uses collaboration and communication management tools. LO1 - The student assumes responsibility for their role in the team and respects cultural diversity. LO2 - The student demonstrates autonomy and initiative in conflict resolution and collaboration facilitation.
Demonstrates lifelong learning ability and the use of IT resources	K1 - The student explains the principles of responsible use of IT resources. S1 - The student uses digital platforms and resources for documentation and learning.

	S2 - The student integrates new information in solving professional tasks. LO2 - The student demonstrates autonomy in selecting and using learning resources.
Displays social responsibility, professional ethics, and civic spirit	K1 - The student describes the principles of professional ethics and social responsibility. K2 - The student explains the ethical implications of professional decisions. S1 - The student applies ethical principles in professional and academic activities. LO1 - The student takes responsibility for the ethical consequences of decisions. LO2 - The student demonstrates autonomy in promoting ethical and civic conduct.
Manages projects and resources in a complex socio-economic context	K1 - The student explains methods of project planning and evaluation. S1 - The student applies project management tools and techniques. S2 - The student develops plans and reports for the efficient use of resources. LO1 - The student takes responsibility for decisions regarding project implementation. LO2 - The student demonstrates autonomy and leadership in managing resources and teams.

* K – knowledge; S – skills; LO – responsibility and autonomy.

6. Course objectives (based on the competence grid)

6.1. General objective	➢ knowledge of processes for the production of the most important petrochemicals and fine chemicals and the impact of raw materials nature on the industrial technologies ➢ knowledge of the most important concepts of fine chemicals ➢ knowledge of main development tendencies in the petrochemistry and fine chemicals synthesis industry
6.2. Specific objectives	➢ knowledge of the main raw materials for petrochemistry and fine chemicals synthesis ➢ knowledge, analysis and systematization of the basic principles in the field and of the technologies for industrial production of petrochemicals and fine chemicals ➢ knowledge of intermediates for the production of pigments, drugs, perfumes, cosmetics products, agrochemicals ➢ solving specific problems using gained knowledge ➢ acquiring new knowledge in the field, using modern information technologies ➢ understanding the current level of the petrochemicals industry and fine chemicals synthesis processes ➢ optimizing the conditions and methods of synthesis taking into account the profitability and environmental aspects of the processes ➢ development of new methods and technologies for the synthesis of petrochemicals and fine chemicals, considering the structural features and the properties of these compounds and the efficiency estimation of the developed methods and technologies ➢ rational choice of the best way to increase the efficiency of existing or new technologies

7. Contents

7.1. Course	Time	Teaching methods	Comments
Trends in petrochemistry. “Greening” the petrochemistry. History of development and complexity of fine chemicals industry	1	Lecture, questioning and debate	
Raw materials for petrochemistry and fine chemicals industry	3		

Technologies for production and use of synthesis gas	4		
Use CO_2 in petrochemical synthesis	2		
Unit processes in petrochemistry	5		
Polymers and biopolymers	4		
Technologies for production of fine chemicals in pharmaceutical, cosmetics and food industries	2		
Technologies for manufacture of main agrochemicals	2		
Dyes and pigments: manufacturing technologies	2		
Green chemistry in the production of fine chemicals, pharmaceuticals and cosmetics	2		
Progress in fine chemicals and speciality chemicals from biomass	1		

Bibliography
1. Ullmann's Encyclopedia of Industrial Chemistry, 40 Volume Set, 7th Edition. Wiley-VCH, 2011
2. Balgacem, M.N., Gandini, A., Monomers, polymers and composites from renewable resources, Elsevier, Amsterdam, Boston, Heidelberg, 2008.
3. Speight, J.G., Handbook of Petrochemical Processes, CRC Press, Taylor and Francis Group, Boca Raton, london, New York, 2019
4. Moulijn, J.A., Makkee, M., Van Diepen, A.E., Chemical process technology, 2nd edition, John Wiley and Sons, Chichester, UK, 2013
5. Cybulski, A., Sharma, M.M., Moulijn, J.A., Sheldon, R.A., Fine chemicals manufacture: Technology and Engineering, Elsevier, 2001
6. Sheldon, R.A., Arends, I., Hanefeld, U., Green chemistry and Catalysis, Wiley – VCH Verlag GmbH and Co. KGaA, Weinheim, Germany, 2007
7. Ekinci, D. (editor), Medicinal chemistry and drug design, INTECHOPEN.COM, Rijeka, Croatia, 2012
8. Verbeek, C.J.R., Products and applications of biopolymers, InTech, Rijeka, 2012
9. Doble, M., Kruthiventi, Green chemistry and processes, Elsevier Inc., Amsterdam, 2007
10. Chauvel, A. Lefebvre, G., Petrochemical processes,vol I, II, InstitutFrancais du Petrole Publications, Editions Technip, Paris, 1989

7.2. Seminar / laboratory	Time	Teaching methods	Comments
Hazard and safety in laboratory; types of reactors and auxiliary tools; physicochemical methods of analysis; writing/making laboratory reports	2	Conversation, explanation, questioning and debate	Compulsory
Synthesis gas by steam and dry reforming of ethanol. Chromatographic analysis of products	8		
Ethylbenzene dehydrogenation with steam/ CO_2 – comparative study. Chromatographic analysis of products	8		
Petroleum and bio- based polymers synthesis	4		
Sustainable composite materials preparation	4		
Processing and interpretation of experimental results. Numerical applications. Evaluation of knowledge	2		

Bibliography
1. Ullmann's Encyclopedia of Industrial Chemistry, 40 Volume Set, 7th Edition. Wiley-VCH, 2011
2. Kirk-Othmer Encyclopedia of Chemical Technology Fourth Edition, John Wiley & Sons, 1998;
3. Opris, I., Cigolea, V., Movileanu, D., Petrochimie – Caiet de lucrari practice, ed. a II-a, vol I, UPG, Ploiesti, 2001
4. Specialized journals

7.3. Project	Time	Teaching methods	Comments

Bibliography

8. Correlation of the course contents with the demands of the epistemic community representatives, professional associations and representative employersin the field of the program

The contents of the course and the laboratory activities are in agreement with the curricula of other universities, from our country or abroad. In order to better adapt the curriculum content to the requirements of labour market, meetings with economic partners, graduates and teachers from faculties in chemical engineering field were held.

9.Evaluation

Activity	9.1. Evaluation criteria	9.2. Evaluation methods	9.3. Percentage of final grade
9.4. Course	Theoretical knowledge, evaluated by questions on the subjects presented during the course	Oral assessment	70%
	Applicative knowledge, evaluated by solving problems/numerical applications		
9.5. Seminar / laboratory	General and detailed knowledge about processes studied in the laboratory	Evaluation of activity and laboratory reports	10%
	Applicative knowledge, evaluated by solving specific problems of the petrochemical processes and fine chemicals synthesis		
		Homework evaluation. Presentation of scientific report	20%
9.6. Project			
9.7. Minimum performance standard			
➢ For mark 5: solving 50% of the theoretical and applicative questions/items - for the exam ➢ For mark 5: obtaining 50% of the points granted for general knowledge and demonstration of the minimum level in understanding and use of laboratory specific knowledge and activities – for the laboratory session			

Signature/date	Course coordinator	Laboratory coordinator	Project coordinator
22.09.2025	Assist. Prof. Ph.D. Eng. Movileanu Daniela	Assist. Prof. Ph.D. Eng. Movileanu Daniela	

Date of approval in the department	Head of department	Dean
26.09.2025	Associate Professor PhD. Mihaela Neagu	Assistant Professor PhD. Cristina Dusescu – Vasile