COURSE SYLLABUS

1. Program information

1.1. Institution	Petroleum - Gas University of Ploiesti
1.2. Faculty	Petroleum Refining and Petrochemistry
1.3. Department	Petroleum Processing Engineering and Environmental Protection
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	Lecturer Ph.D. Eng. Movileanu Daniela Luminița		
2.3. Laboratory / seminar coordinator	Lecturer Ph.D. Eng. Filotti Liviu		
2.4. Project coordinator	-		
2.5. Year of study	I		
2.6. Semester *	2		
2.7. Evaluation type	E		
2.8. Course type - formative category **	DF	2.8. Type of subject matter ***	C

* the semester number is in accordance with the curriculum;

** fundamental = DF; domain = DD; speciality = DS; complementary = DC; thoroughgoing = DA; synthesis = DSI.

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

3. Total estimated time (teaching hours per semester)

3.1. Number of hours per week	5	of which: 3.2. course	3	3.3. Seminars/laboratories	2	3.4 Project	-
3.5 Total hours from curriculum	70	of which: 3.6. course	42	3.7 Seminars/laboratories	28	3.8 Project	-

3.9 Time distribution	hours
Study of textbook, course support, bibliography and notes	15
Further reading in the library, on online platforms and fieldwork	8
Preparing seminars/laboratories, homework, portfolios and essays	13
Tutoring	0
Examinations	2
Other activities	0

3.10. Total hours of individual study	38
3.11. Total hours per semester	70
3.12. Number of credits	108

3. Prerequisites (where applicable)

4.1. of curriculum	➢ graduated bachelor
4.2. of skills	➢ knowledge of organic chemistry, catalysis, mathematics, chemical reactors, use of computer technologies for data acquisition and processing and for documentation

4. Requirements (where applicable)

5.1. of course	➢ Course room with video projector
5.2. of seminars/laboratory	➢ Laboratory with micropilot plants

5. Specific competences

Professional competences	PC1. Description, analysis and advanced utilization of engineering concepts and fundamental theories in petroleum refining. PC2. Characterization of physical and chemical structural properties of petroleum products by complex analytic methods PC3. Equipment, process and plant design. PC4. Real time control of processes and plants in chemical industry. PC5. Modeling, simulation and design of chemical processes.
Cross curricular competences	TC1.Documentation, information and scientific literature research TC2. Independent and autonoms achievement of individual professional tasks. TC3. Advanced knowledge of computer, internet and specific chemical engineering software TC4. Management organization and planning of professional teams and organizations.

6. Course objectives (based on the competence grid)

7.1. 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
7.2. 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

8.1. Course	Time	Teaching methods	Comments
Trends in petrochemistry. "Greening" the petrochemistry. History of development and complexity of fine chemicals industry	2	Lecture, questioning and debate	
Raw materials for petrochemistry and fine chemicals industry	4		
Technologies for production and use of synthesis gas	4		
Use CO_2 in synthesis of petrochemicals	2		
Manufacturing of carbon based materials	2		
Unit processes in petrochemistry	9		
Polymers and biopolymers	5		
Main reactions and methods for fine chemicals synthesis	3		
Technologies for production of fine chemicals in pharmaceutical, cosmetics and food industries	4		
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. Kirk-Othmer Encyclopedia of Chemical Technology Fourth Edition, John Wiley & Sons, 1998
3. 3. Lebedev, N.N., Chemistry and technology of basic organic and petrochemical synthesis, vol 1+2, Mir Publ., Moscova, 1981
4. Chauvel, A. Lefebvre, G., Petrochemical processes,vol I, II, Institut Francais du Petrole Publications, Editions Technip, Paris, 1989
5. Matar, S., Hatch, L.F., Chemistry of petrochemical processes, 2nd edition, Gulf Publishing Company, Houston, Texas, 2000
6. Silla, H., Chemical process engineering. Design and economics, Marcel Dekker, New York, 2003
7. Chaudhuri, U.R., Fundamentals of Petroleum and Petrochemical Engineering, CRC Press, Boca Raton, London, New York, 2011
8. Moulijn, J.A., Makkee, M., Van Diepen, A.E., Chemical process technology, 2nd edition, John Wiley and Sons, Chichester, UK, 2013
9. Cybulski, A., Sharma, M.M., Moulijn, J.A., Sheldon, R.A., Fine chemicals manufacture: Technology and Engineering, Elsevier, 2001
10. Sheldon, R.A., Arends, I., Hanefeld, U., Green chemistry and Catalysis, Wiley – VCH Verlag GmbH and Co. KGaA, Weinheim, Germany, 2007
11. Turton, R., Bailie, R.C., Whiting, W.B., Shaeiwitz, J.A., Analysis, synthesis and design of chemical processes, 3-rd edition, Prentice Hall, New Jersey, Boston, 2009
12. Ekinci, D. (editor), Medicinal chemistry and drug design, INTECHOPEN.COM, Rijeka, Croatia, 2012
13. Verbeek, C.J.R., Products and applications of biopolymers, InTech, Rijeka, 2012
14. Doble, M., Kruthiventi, Green chemistry and processes, Elsevier Inc., Amsterdam, 2007

8.2. 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 reforming of methane/methanol. Chromatographic analysis of products	4		
Styrene by ethylbenzene dehydrogenation (with steam/with CO_2). Chromatographic analysis of products	8		
Styrene/Methylmethacrylate polymerization – suspension and emulsion techniques	6		
Furfural from bio-resources (pentozanes)	4		
Processing and interpretation of experimental results. Numerical applications. Evaluation of knowledge	4		

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			
8.3. Project	Time	Teaching methods	Comments
Bibliography			

9. Correlation of the course contents with the demands of the epistemic community representatives, professional associations and representative employers in the field of the program

The course syllabus was developed in cooperation with representatives of engineering companies in Ploiești and Bucharest that have hired graduates of similar master programs.

10. Evaluation

Activity	10.1. Evaluation criteria	10.2. Evaluation methods	10.3. Percentage of final grade
10.4. Course	Theoretical knowledge, evaluated by questions on the subjects presented during the course	Oral assessment	80%
	Applicative knowledge, evaluated by solving problems/numerical applications		
10.5. Seminar / laboratory	General and detailed knowledge about processes studied in the laboratory	Evaluation of activity and laboratory reports	20%
	Applicative knowledge, evaluated by solving specific problems of the petrochemical processes and fine chemicals synthesis		
10.6 Project			
10.7. Minimum performance standard			
➢ For mark 5: minimum attendance at the course 75%; 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			