COURSE SYLLABUS

1. Program information

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

2. Course information

2.1. Course title	Dynamic simulation and advanced control systems for chemical processes		
2.2. Course coordinator	Prof.dr.eng. Pătrăşcioiu Cristian		
2.3. Laboratory / seminar coordinator	Assist. PhD. Eng Popescu Marian		
2.4. Project coordinator	-		
2.5. Year of study	2		
2.6. Semester *	3		
2.7. Evaluation type	Ex		
2.8. Course type - formative category **	DS	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	-
3.5Total hours from curriculum	50	of which: 3.6. course	30	3.7Seminars/laboratories	20	3.8 Project	-

3.9Time distribution	hours
Study of textbook, course support, bibliography and notes	10
Further reading in the library, on online platforms and fieldwork	10
Preparing seminars / laboratories, homework, portfolios and essays	10
Tutoring	-
Examinations	10
Other activities	-

3.10. Total hours of individual study	40
3.11. Total hours per semester	90
3.12. Number of credits	5

4. Prerequisites (where applicable)

4.1. of curriculum	➢ Basic Chemical Processes Control
4.2. of skills	➢ Physical, chemical, mathematics knowledge ➢

5. Requirements (where applicable)

5.1. of course	➢ Class room with table, multimedia equipment
5.2. of seminars/laboratory	➢ Laboratory room, table, industrial control systems, chemical process simulator, distributed system simulators

6. Specific competences

Professional competences	➢ Description, analysis and advanced utilization of engineering concepts and fundamental theories in petroleum refining. ➢ Real time control of processes and plants in chemical industry.
Cross-curricular competences	➢ Documentation, information and scientific literature research ➢ Independent and autonomous achievement of individual professional tasks ➢ Advanced knowledge of computer, internet and specific chemical engineering software.

7. Course objectives (based on the competence grid)

7.1. General objective	➢ Dynamic 2odeling and simulation of chemical processes ➢ Advanced control of chemical processes
7.2. Specific objectives	➢ Numerical solving of differential equations ➢ Dynamic 2odeling of simple chemical processes ➢ Dynamic 2odeling of distillation processes ➢ Dynamic 2odeling of automatic control systems ➢ Fundamentals of automatic control systems for chemical processes ➢ Structures of automatic systems for chemical processes ➢ Modelling and simulation of automatic systems structures ➢ Design, operation and exploitation of automatic control systems

8. Contents

8.1. Course	Time	Teaching methods	Comments
1. Analytical and numerical solving of ordinary differential equations	4	Interactive lecture, written course, video projector	
2. Dynamic simulation of fractionation processes using Unisim environment	6		
3. Advanced automated control systems for tubular furnaces	8		
4. Advanced automation of fractionation and absorption columns	8		
5. Automatic control of atmospheric distillation columns	4		

Bibliography

1. Patrascioiu C., Popescu M., *Dinamica sistemelor chimice*, Editura MatrixRom, Bucuresti, 2015.
2. Franks R.G.E., *Modelarea si simularea in ingineria chimica*, Editura Tehnica, Bucuresti 1979.

3. Patrascioiu C., Popescu M., *Sisteme de conducere a proceselor chimice – Aplicatii*, Editura MatrixRom, Bucuresti, 2013.
4. Patrascioiu C., *Metode numerice aplicate in ingineria chimica – Aplicatii PASCAL*, Editura MatrixRom, Bucuresti, 2005.
5. Bequette B.W., *Process Control – Modeling, Design and Simulation*, Pearson Education Inc.New Jersy 2003.
6. Pătrășcioiu C., *Sisteme de conducere a proceselor chimice*, Note de curs.
7. Constantinides A., Moustoufi N., *Numerical Methods for Chemical Engineers with MATLAB Applications*, Prientice Hall, 1999.
8. Paraschiv N., Popescu M., Pătrăşcioiu C. – Advanced real time control of an industrial mass transfer process, Proceedings of the International Conference on Computational Heat and Mass Transfer (ICCHMT09), Guangzhou, China, 2009, pp 602-607.
9. Popescu M., Distillation Column Hierarchical Control, REV. CHIM. (Bucharest), 69, No. 9, p 2595-2600, 2018.

8.2. Seminar / laboratory	Time	Teaching methods	Comments
1. Steady-state simulation of chemical processes using Unisim environment	2	Unisim Design software	
2. Dynamic simulation of chemical processes	4	Unisim Design software	
3. Static characteristics of tubular furnaces	4	Simulation program in PASCAL Simulation program in Unisim Design	Application book
4. Simulation of temperature control system for a tubular furnace	2	Simulation program in MATLAB/SIMULINK	Application book
5. Selection of commands for a fractionation column	2	Simulation program in Unisim Design	
6. Feedback control of products quality for a binary fractionation column	4	Simulation program in Unisim Design	
7. Feedforward control of products quality for a binary fractionation column	2	Simulation program in Unisim Design	

Bibliography

1. Patrascioiu C., Popescu M., Dinamica sistemelor chimice, Editura MatrixRom, Bucuresti, 2015.
2. Patrascioiu C., Metode numerice aplicate in ingineria chimica – Aplicatii PASCAL, Editura MatrixRom, Bucuresti, 2005.
3. Patrascioiu C., Popescu M., *Sisteme de conducere a proceselor chimice – Aplicatii*, Editura MatrixRom, Bucuresti, 2013.
4. Constantinides A., Moustoufi N., *Numerical Methods for Chemical Engineers with MATLAB Applications*, Prientice Hall, 1999.
5. Honeywell, UniSim® Design Dynamic Modeling – Reference Guide, 2016.

8.3. Project	Time	Teaching methods	Comments
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Bibliography

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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	Analytical solving and numerical solving algorithms of ordinary differential equations	Written test	20
	Knowledge of dynamic models of simple systems	Written test	20
	Understanding fundamentals of control systems	Written test	20
	Knowledge of the static characteristics of automated processes	Written test	10
10.5. Seminar / laboratory	Numerical solving of ordinary differential equations	Homework	10
	Modelling and numerical simulation of simple systems	Homework	10
	Determination of dynamic characteristics of automatic systems	Test	10
10.6 Project	-	-	-
10.7. Minimum performance standard			
➢ Analytical solving of an ordinary differential equation and graphical representation of the solution ➢ Dynamic model of a CSTR ➢ An example of a static characteristic of a process ➢ An example of advanced control system			