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	Thermal integration, energy efficiency and utility systems
2.2. Course coordinator	Assist. Prof. PhD. Eng. Negoiţă Loredana Irena
2.3. Laboratory / seminar / coordinator	Assist. Prof. PhD. Eng. Negoiță Loredana Irena
2.4. Project coordinator	Assist. Prof. PhD. Eng. Negoiță Loredana Irena
2.5. Year of study	1
2.6. Semester *	II
2.7. Evaluation type	written exam + oral project support
2.8. Course type - formative category **/ Type of subject matter ***	DD/MND

* The semester number is according to the curriculum.

** FC – Fundamental courses; SC – Specialization courses; CC – Complementary courses.

*** Mandatory/imposed = MND; Optional = OPT; Elective = ELE.

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	1	3.4.Project	1
3.5. Total hours from curriculum	56	of which: 3.6. course	28	3.7. Seminar/laboratory	14	3.8. Project	14
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. Requirements (where applicable)

4.1. Curriculum requirements	➢ Heat transfer processes, Thermoenergetics
4.2. Course requirements:	The classroom with blackboard, screen, video projector
4.3.Seminar/Laboratory requirements:	The room with blackboard, screen, video projector, computers

5. Specific competences acquired and learning achievements* outcomes

Professional competences	Learning achievements*
1. 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.
2. 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. K3 - The student defines computational methods for process simulation and optimization. **A1** The student applies specialized software for process design and analysis. A2 - 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.
Transversal competences	**Learning achievements***
1. 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 **LO1** - The student demonstrates autonomy in selecting and using learning resources
2. 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

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

6. Course objectives (derived from the list of specific competences acquired)

6.1. General objective	The main objective of the course is to deepen and develop knowledge in the fields of heat transfer and thermoenergetics in order to facilitate the finding of energy efficient solutions in certain technological processes.
6.2. Specific objectives	At the end of the course, students will be able to: - identify the practical situations in which heat transfer mechanisms

	occur; - illustrate the role of utility systems in technological processes; - define and list the composition and characteristics of heat supply systems and utilities; - find solutions to increase energy efficiency.

7. Contents

7.1. Course	Time	Teaching methods	Comments
1. Heat Transfer Mechanisms	2	Interactive exposition, problem-solving, heuristic conversation, exemplification.	
2. Partial and overall heat transfer coefficients	2		
3. Heat exchangers. Thermal and hydraulic calculation	2		
4. Performance indicators of heat exchangers. Increase the efficiency of heat exchangers	2		
5. Combustion processes. Tubular furnaces. Real and optimized heat balance	2		
6. Thermal energy regenerative systems	2		
7. Thermal energy recovery systems	2		
8. Cooling water systems used in refinery	2		
9. Production and use systems of steam in refinery	2		
10. Thermoenergetics systems with cogeneration	3		
11. Thermal integration of heat exchanger networks using the Pinch method	3		
12. Fuel supply systems	2		
13. Inert gas supply systems	2		

Bibliography

1. Incropera, F., Dewitt, D. P., Fundamentals of heat and mass transfer, Seventh edition, John Wiley and Sons, U.S.A., 2011.
2. Popescu, N., Dinu, R. C., Energetica instalaţiilor de producere a energiei în cogenerare, Editura Universitară, Craiova, 2013.
3. Allan, P. R., Improve Energy Efficiency via Heat Integration, American Institute on Chemical Engineering, December, 2010.
4. Cao, E., Heat transfer in process engineering, The McGraw-Hill Companies, USA, 2010.
5. Green, D.W, Perry R. H., Perry's Chemical Engineers' HandBook, 8nd ed., McGrawHill, USA, 2008.
6. Lienhard, J. H. IV, Lienhard J.H.V, A heat transfer Textbook, 4th ed., Phlogiston Press, Cambridge, Massachusetts, U.S.A., 2011.
7. Rokni, M., Introduction to Pinch Technology, Kgs. Lyngby: Technical University of Denmark, 2016, http://orbit.dtu.dk/files/123620478/Pinch_Tech_1.pdf.
8. Jiří, J. K., Zdravko, K., Forty years of Heat Integration: Pinch Analysis (PA) and Mathematical Programming (MP), Current Opinion in Chemical Engineering, Vol. 2, No. 4, 2013.

7.2. Seminar	Time	Teaching methods	Comments
Logarithmic mean temperature difference for flows in a heat exchanger. Heat exchangers - with and without phase transformation - applications	6	Seminars are conducted interactively, discussing the results	
Combustion calculations and thermal balances on furnaces - applications	2		
Thermal power plants - applications	2		
Optimizing a heat exchanger network by applying the PINCH method - example of calculation	4		

Bibliography

1. Green, D.W, Perry R. H., Perry's Chemical Engineers' HandBook, 8nd ed., McGrawHill, USA, 2008.
2. Allan, P. R., Improve Energy Efficiency via Heat Integration, American Institute on Chemical Engineering, December, 2010.
3. Lienhard, J. H. IV, Lienhard J.H.V, A heat transfer Textbook, 4th ed., Phlogiston Press, Cambridge, Massachusetts, U.S.A., 2011.
4. Rokni, M., Introduction to Pinch Technology, Kgs. Lyngby: Technical University of Denmark, 2016, http://orbit.dtu.dk/files/123620478/Pinch_Tech_1.pdf.

7.3. Project	Time	Teaching methods	Comments
Presentation of a technological unit	1	Interactive exposition, problem-solving, discussing the results	
Establishing initial design data, example application	2		
Presentation of the thermal balance for a heat exchanger	2		
Calculation of heat transfer coefficients for the heat exchanger; Setting the calculation algorithm in the Excel program. Simulation of results with PROII software.	6		
Interpretation of the results obtained	1		
Project evaluation	2		

Bibliography

1. Dobrinescu, D., Procese de transfer termic şi utilaje specifice, EDP, Bucureşti, 1983.
2. Pătraşcu, C., Termoenergetica prelucrării petrolului, Editura UPG, Ploieşti, 2003.
3. Popa , B., Manualul inginerului termotehnician,Ed.Tehnică, Bucureşti,1986.
4. Ludwig, E., Applied Process Design for chemical and Petrochemical Plants, Golf Publishing Company, Texas,1987.
5. Incropera, F., Fundamentals of Heat and Mass Transfer, John Wiley & Sons, New York, 2002.
6. Leca, A., Transfer de căldură şi masă, Ed. Tehnică, Bucureşti, 1998.

8. 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 content of the course, seminar and project correspond to the curriculum from other university centres, from the country or from abroad. In order to better adapt to the requirements of the labour market the

content of the course, meetings were held, both with representatives of economic partners, with graduates, as well as with teachers from the faculties that specialize in chemical engineering.

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 related to the subjects presented in the course	Written exam	40 %
9.5. Seminar / laboratory	Applied knowledge evaluated by solving problems / numerical applications similar to those presented at the seminar	Written exam	30%
9.6. Project	Theoretical knowledge evaluated by questions related to the subjects presented in the project; Rhythmicity for each stage of the project.	Oral project support	30 %
9.7. Minimum performance standard			
Written examination: ➢ For 5, it is necessary to obtain a minimum score of 50% for theoretical knowledge, as well as to prove a minimum level of understanding and solving the applications in the exam subject (minimum 50%). For 10 it is necessary to obtain a maximum score for theoretical knowledge and complete and correct solving of the applications in the exam subject (minimum 95%).			

Signature date	Course coordinator	Seminar/laboratory coordinator	Project coordinator
22.09.2025	Assist. Prof. PhD. Eng. Negoiță Loredana Irena	Assist. Prof. PhD. Eng. Negoiță Loredana Irena	Assist. Prof. PhD. Eng. Negoiță Loredana Irena

Date of approval in the department	Head of department	Dean
___26.09.2025_______	Associate Prof. PhD. eng. Mihaela Neagu	Assistant Prof. PhD. eng. Cristina Dușescu-Vasile