FACULTY CHEMISTRY

SUBJECT CARD

Name of subject in English: Chemical process project designed and management
Main field of study (if applicable): Inżynieria chemiczna i procesowa
Specialization (if applicable): Advanced Chemical Engineering and Nanotechnology
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: obligatory
Subject code: ICC024035
Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45		15	60	30
Number of hours of total student workload (CNPS)	150		60	120	60
Form of crediting	exam		crediting with grade	crediting with grade	crediting with grade
For group of courses mark (X) final course					
Number of ECTS points	5		2	4	2
including number of ECTS points for practical (P) classes			2	4	2
including number of ECTS points for direct teacher-student contact (BK) classes	1,5		0,5	2	1

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of organic and inorganic chemical technology.
2. Basic knowledge of Quality Management Systems.
3. Basic knowledge of unit processes and apparatus solutions in chemical engineering.
4. Basic knowledge of environmental protection.
5. Basic knowledge of chemical process design.
6. Knowledge of simulation and design programs for chemical installations.

SUBJECT OBJECTIVES

C1. Acquainting students with the principles of Sustainable Development, the balance between economy, ecology and social issues, in the context of requirements for modern functioning of chemical companies.
C2. Obtaining basic knowledge about the sector of basic chemicals production, raw materials and cooperation links with the chemical processing sector.
C3. Acquainting student with the technical dossier for substance which is manufactured in or imported into UE under REACH.
C4. Understanding the nature and role of quality management in the production process, use it in the implementation of technology and the development of basic documents in this field.
C5. Providing students with a general knowledge of the concepts of production economics.
C6. Providing student with understanding and practical application of knowledge of modeling chemical and biotechnological processes.
C7. Understanding the basic methods of industrial waste management.
C8. Understanding the current trends in the development of industrial waste disposal technologies.
C9. Understanding the principles of developing project documentation.
C10. Understanding the principles of integrated process design.
C11. Acquiring the ability to present work results.

C12. Working knowledge of using a professional software for calculation of optimal process parameters and costs of processing.

SUBJECT LEARNING OUTCOMES

related to knowledge:

PEK_W01 – Student has basic knowledge about the procedures of the European integrated permitting system for industries based on chemical technologies.
PEK_W02 – Knows basic techniques and technologies recognized as the best available technologies (BAT).
PEK_W03 – Has knowledge on obligation of actor in supply chain to register chemical substances under REACH that are manufactured in or imported into the EU and can define 7 key steps toward successfully registration.
PEK_W04 – Knows the key concepts and issues in the field of production management and organization of the production system, principles of technology strategy as well as rules of technology choice.
PEK_W05 – Knows how to perform economic analysis of industrial installation, able to produce required product.
PEK_W06 – Knows methods of optimization of unit operations and complete process lines.
PEK_W07 – Knows the types of waste generated in industry and the ways of their management.
PEK_W08 – Has in-depth knowledge of development trends and new achievements in the field of chemical and process engineering.

related to skills:

PEK_U01 – Student has the knowledge and skills in the use of selected quality tools and methods as well as assessing the ability of production process.
PEK_U02 – Student can prepare a technological concept and develop a final specification of a new product in accordance with applicable standards.
PEK_U03 - Is able to perform process optimization calculations.
PEK_U04 - Can choose the construction materials of devices for the technological process.
PEK_U05 – Is able to choose a sequence of unit operations for the technological process.
PEK_U06 – Can perform economic analysis of chemical and biotechnological installation.
PEK_U07 – Acquires, critically evaluates and creatively processes information from scientific literature, databases and other properly selected sources.
PEK_U08 – Is able to present the goals and results of the scientific work in the form of an oral presentation using modern information and communication techniques.

related to social competences:

PEK_K01 – Student is aware of the benefits of implementing a quality management system in the company.
PEK_K02 – Is ready to act and think in an entrepreneurial way.
PEK_K03 – Is able to cooperate in a design group.
PEK_K04 – Can present the results of the work.

PROGRAMME CONTENT

	Lectures	**Number of hours**
Lec 1	Introduction, fundamentals, terminology, definitions. Environmental protection principles in the EU. EU directive on integrated pollution prevention and control. Categories of economic activity requiring an integrated permit.	2
Lec 2	BAT for large-scale production of inorganic and organic chemicals. Applied technologies, emission factors, reference technologies, solutions used for existing installations to improve their environmental impact indicators.	2
Lec 3	Obligations and exemptions of REACH registration - identification and classification of a substance.	2
Lec 4	Key steps toward successfully REACH registration, technical dossier and a chemical safety assessment.	2
Lec 5	Issues concerning management systems of quality, environment, occupational health and	2

	safety as well as management in laboratory, selected industry standards).	
Lec 6	Organization and management of the production process - preparation of plans, budgets, production.	2
Lec 7	Technological strategy, selection of technology - selection rules and implementation of technology.	2
Lec 8	Partial test.	1
Lec 9	Concept of production. Factors of production.	2
Lec 10	Theory of production. Short-run production costs.	2
Lec 11	Long-run production costs. Research-project-implementation cycle.	2
Lec 12	Design of installation. Cost of scale-up.	2
Lec 13	Selection of optimal production method. Bottlenecks.	2
Lec 14	Payback time. Product lifetime.	2
Lec 15	Analysis of selected processes.	2
Lec 16	Partial test.	1
Lec 17	Issues, preliminary definitions and current legal regulations in waste management.	2
Lec 18	Organization of industrial waste management. Circular economy.	2
Lec 19	General waste classification. Selected groups of industrial waste and their characteristics.	2
Lec 20	Waste treatment methods for industrial waste. Selective collection and recycling of waste. Recovery of raw materials and energy from industrial waste.	2
Lec 21	Selected examples of processes and devices used in the processing of chemical industrial waste.	2
Lec 22	Selected examples of processes and devices used in the processing of industrial bio-waste.	2
Lec 23	An overview of the latest trends in the development of industrial waste disposal technologies.	2
Lec 24	Partial test.	1
	Total	**45**

Laboratory		**Number of hours**
Lab 1	Introduction. Safety regulations. SuperPro Designer introduction.	3
Lab 2	Optimal process parameters. Optimization of construction. Process timeline.	3
Lab 3	Gantt graphs. Resources management. Order of separation processes. Up-stream and down-stream processes. Costs of separation.	3
Lab 4	Membrane processes. Diffusion processes.	3
Lab 5	Bottlenecks. Remediation processes.	3
	Total	**15**

Project		**Number of hours**
Proj 1	Introduction, organization, discussion of the scope of classes. Product Selection, features, standards, requirements, the program of the production process progress and planning of production capacity.	2
Proj 2	Market analysis and marketing aspects of quality, location planning and assessment of project impact on the environment.	2
Proj 3-4	Presentation of the initial technological concept for the selected product.	4
Proj 5	Structure of the Quality Manual in accordance with the principles of ISO 9001 regarding the supervision of documentation.	2
Proj 6-7	Tools and methods for the improvement of quality – exercises.	4

Proj 8	Submission of a technological concept for the selected product.	1
Proj 9	Introduction to integrated process design - diagrams, standards, preparation of the schematic diagram, material balance, apparatus and technology diagram.	9
Proj 10	Modeling, evaluation and optimization of processes.	9
Proj 11	Integrated design - process economics, materials selection and industrial waste management.	9
Proj 12	Preparation of piping diagram and instrumentation.	9
Proj 13	Integrated process evaluation.	5
Proj 14	Autopresentation.	4
	Total	**60**

Seminar		**Number of hours**
Proj 1	Choosing the subjects of presentations.	2
Proj 2	Content of presentations.	2
Proj 3	General processes balances. Streams. Planned costs analysis.	2
Proj 4	Choosing the right equipment. Costs of apparatuses.	2
Proj 5	Resources sources and management.	2
Proj 6	Waste management.	2
Proj 7	Process analysis and optimization.	2
Proj 8	Presentations of individual problem issues.	12
Proj 9	Final project presentations.	4
	Total	**30**

TEACHING TOOLS USED

N1. Lecture with multimedia presentation.
N2. Presentation of semester work.
N3. Solving tasks and problems for elaborated project.
N4. Preparation and presentation of a project.
N5. Development of project documentation with the use of computer programs packages.
N6. The use of specialized software for creating individual projects.
N7. Consultation.
N8. Didactic trip for chemical installation.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1 (lecture)	PEK_W01-PEK_W04	Partial test
F2 (lecture)	PEK_W05-PEK_W06	Partial test
F3 (lecture)	PEK_W07-PEK_W08	Partial test

P (lecture)= F1+F2+F3

P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

P (laboratory)	PEK_U06-PEK_U07 PEK_K03	Project prepared using a dedicated software

P (laboratory)
P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

F1 (project)	PEK_U01	Solving tasks
F2 (project)	PEK_U02 PEK_K01	Presentation and submission of a technological concept for the selected product
F3 (project)	PEK_U08 PEK_K02-PEK_K04	Autopresentation
F4 (project)	PEK_U03-PEK_U05 PEK_K02-PEK_K04	Project evaluation

P(project) = (0,3 F1+0,7 F2+0,4 F3 +0,6 F4)/2
P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

F1 (seminarium)	PEK_U08 PEK_K03-PEK_K04	Presentation
F2 (seminarium)	PEK_U08 PEK_K03-PEK_K04	Presentation

P(seminarium)=F1+F2
P = 3.0 if the sum of points in the range 50-60%
3.5 if the sum of points in the range 61-72%
4.0 if the sum of points in the range 73-82%
4.5 if the sum of points in the range 83-92%
5.0 if the sum of points in the range 93-100%
5.5 if the sum of points is 100%, and the student demonstrates the knowledge above the regular material scope

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] B. Sujak-Cyrul, Quality management systems: an introduction to the project of documenting and audit of quality management systems, Wrocław, Wrocław University of Technology; Łódź: PRINTPAP, 2011.
[2] S.E. Windsor, An introduction to green process management, Milwaukee, Wis.: ASQ Quality Press, cop. 2011.
[3] N.R. Tague, The quality toolbox, Milwaukee, Wis.: ASQ Quality Press, 2005.
[4] Official website of European Chemical Agency https://echa.europa.eu/pl.
[5] Best available techniques Reference document (BREFs) developed under the IPPC Directive and the IED http://eippcb.jrc.ec.europa.eu/reference.
[6] F.N. Fraser, Global engineering economics, Financial decision making for engineers, 4th Ed., Prentice Hall, Toronto, 2009.
[7] E. Heinzle, A.P. Biwer, C.L. Cooney - Development of Sustainable Bioprocesses: Modeling and Assessment, Viley 2006.
[8] L.T. Blank, A. Tarquin, Engineering Economy, 6th Ed., McGraw-Hill, Boston, 2005.
[9] Cz. Rosik-Dulewska, Podstawy gospodarki odpadami, Wydawnictwo Naukowe PWN, Warszawa 2015.

[10] T. Piecuch, J. Dąbrowski, Procesy i urządzenia w przeróbce odpadów przemysłowych, Wydawnictwo Uczelniane Politechniki Koszalińskiej, Koszalin 2016.
[11] R. Turton, R. C. Bailie, W. B. Whiting, J. A. Shaeiwitz, D. Bhattacharyya, Analysis, Synthesis and Design of Chemical Processes, 4th Edition, Prentice Hall, 2012.
[12] W.D. Seider, D.R. Lewin, J.D. Seader, S. Widagdo, R. Gani, K- Ming. Ng, Product and Process Design Principles: Synthesis, Analysis and Evaluation, 4th Edition, Wiley, 2016.
[13] Lista tematów projektowych – do wyboru.
[14] Lista BAT odpowiednich do tematów projektowych.

SECONDARY LITERATURE:

[1] Woodard & Curran, Inc., Industrial Waste Treatment Handbook, Elsevier, 2006.
[2] S. Zabawa, Zarządzanie gospodarką odpadami: techniczno-organizacyjno-prawne aspekty gospodarki odpadami, Polskie Zrzeszenie Inżynierów i Techników Sanitarnych Oddział Wielkopolski, Poznań 2010.
[3] B. Tora, Niekonwencjonalne metody wykorzystania odpadów przemysłowych, Wydawnictwa AGH, Kraków 2013.
[4] D. A. Vallero, Environmental Biotechnology: A Biosystems Approach, Academic Press, 2010.
[5] G.M. Evans, J.C. Furlong, Environmental Biotechnology: Theory and Application, Wiley, 2002.
[6] H.V. Mott, Environmental Process Analysis: Principles and Modeling, Wiley, 2013.
[7] R.C. Gaur, Basic Environmental Engineering Paperback, New Age International Publisher, 2008.
[8] R.G. Harrison, P. Todd, S.R. Rudge, D.P. Petrides - Bioseparations Science and Engineering, Oxford, 2002.
[9] Instrukcja użytkownika do program SuperPro Designer.

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