

| FACULTY OF CHEMISTRY  |   |         |            |         |         |
|---|---|---------|------------|---------|---------|
| <b>SUBJECT CARD</b>   |   |         |            |         |         |
| Name of subject in Polish:  | Podstawowe procesy jednostkowe w technologii chemicznej |         |            |         |         |
| Name of subject in English:   | Basic unit processes in chemical technology             |         |            |         |         |
| Main field of study (if applicable):  |   |         |            |         |         |
| Specialization (if applicable): -   |   |         |            |         |         |
| Profile:  | academic  |         |            |         |         |
| Level and form of studies:  | 2nd level – supplementary semester, full-time           |         |            |         |         |
| Kind of subject:  | Optional  |         |            |         |         |
| Subject code  | TCC020024   |         |            |         |         |
| Group of courses  | NO  |         |            |         |         |
|   | Lecture   | Classes | Laboratory | Project | Seminar |
| Number of hours of organized classes in University (ZZU)  | 30  |         |            |         |         |
| Number of hours of total student workload (CNPS)  | 90  |         |            |         |         |
| Form of crediting   | credit  |         |            |         |         |
| For group of courses mark (X) final course  |   |         |            |         |         |
| Number of ECTS points   | 3   |         |            |         |         |
| including number of ECTS points for practical (P) classes   |   |         |            |         |         |
| including number of ECTS points for direct teacher-student contact (BK) classes   | 1   |         |            |         |         |
| <b>PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES</b>  |   |         |            |         |         |
| 1. Basic knowledge of general and physical chemistry  |   |         |            |         |         |
| 2. Knowledge of elementary mathematics  |   |         |            |         |         |
| <b>SUBJECT OBJECTIVES</b>   |   |         |            |         |         |
| C1 To familiarize students with the concepts of processes and unit operations   |   |         |            |         |         |
| C2 Learning the principles of operation of basic apparatus and reactors for the implementation of processes and unit operations in various phase systems                      |   |         |            |         |         |
| C3 Introduction to the principles of the implementation of chemical processes in a continuous system  |   |         |            |         |         |
| C4 To familiarize with the principles of the technological sequences of processes and unit operations   |   |         |            |         |         |
| C5 To familiarize students with selected processes of chemical technology, non-catalytic and catalytic processes in a stationary fluid bed                                    |   |         |            |         |         |
| C6 To familiarize students with the specificity of biotechnological processes   |   |         |            |         |         |
| C7 To familiarize students with modern separation operations of chemical substances   |   |         |            |         |         |
| <b>SUBJECT LEARNING OUTCOMES</b>  |   |         |            |         |         |
| <b>Relating to knowledge:</b>   |   |         |            |         |         |
| PEK_W01 student can correctly characterize operations and unit processes used in chemical technology  |   |         |            |         |         |
| PEK_W02 student is able to draw up the technological scheme of the installation and select the apparatus for it, indicate the appropriate processes and unit operations in it |   |         |            |         |         |
| PEK_W03 student can characterize the chemical materials flow in various phase systems   |   |         |            |         |         |
| PEK_W04 knows the principles of catalytic and non-catalytic processes, can describe and characterize them   |   |         |            |         |         |
| PEK_W05 has a basic knowledge of separation techniques  |   |         |            |         |         |
| PEK_W06 has basic knowledge about the biofuels production methods   |   |         |            |         |         |
| PEK_W07 has basic knowledge on the polymerization processes and properties of the obtained materials  |   |         |            |         |         |
| PEK_W08 has basic knowledge in the field of biotechnological processes  |   |         |            |         |         |
| <b>relating to skills:</b>  |   |         |            |         |         |
| PEK_U01 can practically develop a technological scheme of the process and define necessary operations and   |   |         |            |         |         |

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| unit processes<br>PEK_U02 can describe basic operations and unit processes for selected chemical technologies from various fields of chemistry<br>PEK_U03 can perform simple laboratory experiments as individual processes, and perform basic calculations related to their course<br>PEK_U04 can plan and perform simple separation process using membrane techniques<br>PEK_U05 can determine the efficiency of the process<br>PEK_U06 can determine the physico-chemical properties of the reaction products<br>PEK_U07 can plan and carry out the process of raw material chemical modification |   |                        |
| <b>PROGRAMME CONTENT</b>   |   |                        |
| <b>Lectures</b>  |   | <b>Number of hours</b> |
| Lec 1  | Basic information, unit process, unit operation, definitions, characteristics   | 2                      |
| Lec 2  | Diagram of the chemical process, operations and unit processes as components of the technological process. Raw materials, products and by-products of processes and unit operations   | 2                      |
| Lec 3  | Regime and parameters of processes and unit operations. Mixing and mass and heat exchange. Balance in chemical processes, efficiency and conversion of reagents in a chemical process.  | 2                      |
| Lec 4  | The concept of the reaction driving force in systems of various flows, methods of increasing the reaction speed in unit processes   | 2                      |
| Lec 5  | Examples of apparatus solutions for unit processes and operations in the gas-solid, gas-liquid system, three-phase system in a catalytic and non-catalytic system, apparatus solutions for various forms of the catalyst in unit processes. | 2                      |
| Lec 6  | Examples of technological processes, catalytic processes in a fluidized bed, catalytic processes occurring in the presence of a stationary catalyst bed   | 2                      |
| Lec 7  | Non-catalytic processes, high temperature in a heterogeneous system, electrolytic processes   | 2                      |
| Lec 8  | Non-catalytic processes, Enzymatic processes with native and immobilized enzymes. Stability of the systems  | 2                      |
| Lec 9  | Microorganisms. Microbiological processes. Kinetics. Distribution of products.  | 2                      |
| Lec 10   | Separation operations: extraction. distillation, chromatography, sedimentation, flocculation.   | 2                      |
| Lec 11   | Simple membrane operations: microfiltration, ultrafiltration, nanofiltration, reverse osmosis, electrodialysis.   | 2                      |
| Lec 12   | Advanced membrane processes: pervaporation, membrane distillation, membrane processors, hybrid processes.   | 2                      |
| Lec 13   | Addition polymerization: reaction mechanisms, initiators, inhibitors. Condensation polymerization   | 2                      |
| Lec 14   | Molecular masses. Molecular weight distributions. Polymer solutions. Condensed phases   | 2                      |
| Lec 15   | Mixtures. Crystallinity. Temperatures of phase transformations.   | 2                      |
|  | Total hours   | 30                     |
| <b>TEACHING TOOLS USED</b>   |   |                        |
| N1. Multimedia presentation<br>N2. Laboratory exercises<br>N3. Reports on the obtained laboratory results  |   |                        |

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| N4. Consultation   |                          |  |
| <b>EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT</b>   |                          |  |
| <b>Evaluation</b> (F – forming (during semester), P – concluding (at semester end))  | Learning outcomes number | Way of evaluating learning outcomes achievement  |
| P (lecture)  | PEK_W01 –PEK_W07         | 2,0, when 0-50% points<br>3,0, when 51-60% points<br>3,5, when 61-70% points<br>4,0, when 71-80% points<br>4,5, when 81-90% points<br>5,0, when 91-98 % points<br>5,5, when >98 % points |
| <b>PRIMARY AND SECONDARY LITERATURE</b>  |                          |  |
| <b>PRIMARY LITERATURE:</b>   |                          |  |
| <p>[1] I. Mukhlyonov et al. The Theoretical Foundations of Chemical Technology, Part 1 and Part 2. Mir Publishers, Moscow. 1977.</p> <p>[2] M. Bodzek, J. Bohodziewicz, K. Konieczny, Techniki membranowe w ochronie środowiska, Wydawnictwo Politechniki Śląskiej, Gliwice 1997</p> <p>[3] Praca zbiorowa pod red. Z. Florjańczyka, S. Penczka, Chemia polimerów t. III, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1998</p> <p>[4] Szlachta Z., „Zasilanie silników wysokoprężnych paliwami rzepakowymi”, WKŁ Warszawa 2002.</p> <p>[5] Baczewski K., Kałdoński T. „Paliwa do silników o zapłonie samoczynnym”, WKŁ Warszawa 2008</p> <p>[6] Morrison R.T., Boyd R.N. „Chemia organiczna T.1” Wydawnictwo Naukowe PWN, Warszawa 2010</p> |                          |  |
| <b>SECONDARY LITERATURE:</b>   |                          |  |
| [1] T. Winnicki, Polimery w ochronie środowiska, Arkady, Warszawa 1978   |                          |  |
| <b>SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)</b>   |                          |  |
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