(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: UNIT OPERATIONS	**2. Course code**
3. Validity of course description: 2015/2016	
4. Level of studies: 1st cycle of higher education	
5. Mode of studies: intramural studies	
6. Field of study: INDUSTRIAL AND ENGINEERING CHEMISTRY	RCH
7. Profile of studies: -	
8. Programme: general	
9. Semester: 6	
10. Faculty teaching the course: Department of Chemical Engineering and Process Design RCh-3	
11. Course instructor: Krzysztof Piotrowski, PhD, DSc, Assistant Professor	
12. Course classification: field	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: knowledge provided in: Physics, Fluid Mechanics, Process Thermodynamics and Industrial Equipment.	
16. Course objectives: An objective of the course is providing the students with theoretical background of selected unit operations of chemical and process engineering, as well as their selection criteria.	
17. Description of learning outcomes:	

No	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Student possesses theoretical background of selected unit operations of chemical and process engineering	examination	lecture	K_W01+, K_W02+, K_W06+, K_W07+, K_W09+, K_W11+, K_W12+, K_W14+, K_W18+
2.	Student can make simple design calculations concerning: extraction, leaching, convective drying and adsorption, as well as utilize the results in laboratory or industrial practice	examination, credit test	lecture, laboratory	K_U03++, K_U05+, K_U06+, K_U07++, K_U08++, K_U24++, K_U25+
3.	Student can use graphical, numerical methods and specialized programs for practical problems solving	examination, credit test	lecture, laboratory	K_U03++, K_U05+, K_U07++, K_U24++
4.	Student uses literature data, internet, electronic datasets and data processing/communication techniques in design works	examination	lecture	K_U01+
5.	Student uses properly matched unit operations and their parameters for the given problem	examination, credit test	lecture, laboratory	K_U03++, K_U07++, K_U08++, K_U24++, K_U25+
6.	Student understands the necessity of further professional training and the development of his/her engineering and personal competence	observation and discussion	lecture, laboratory, consultation	K_K01+

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Lecture: 30 h / laboratory: 30 h

19. Syllabus description:

Lecture:

Liquid extraction – process characteristics, liquid-liquid equilibria, equipment and flowsheets (single-stage extraction, multistage crosscurrent extraction, continuous countercurrent multistage extraction, fractional extraction, economic balances, stage efficiency), constructions (agitated vessels, mixer–settler cascades, spray and packed towers, mechanically agitated countercurrent extractors).

Leaching – process characteristics, initial preparation of the solid, methods of operation and equipment ("in situ" leaching, percolation tanks, countercurrent multiple contact – the Shank system, filter–press leaching, agitated vessels, leaching during grinding, continuous countercurrent decantation, leaching of vegetable seeds), stage efficiency – practical equilibrium, single–stage leaching, multistage crosscurrent leaching, kinetics of leaching.

Convective drying – process characteristics, equilibrium moisture content, drying operations (batch and continuous), kinetics of batch drying, mechanisms of batch drying, critical moisture content, drying tests, equipment.

Adsorption – process characteristics, adsorption types (physical adsorption, chemisorption), nature of adsorbents, adsorption equilibrium, heat of adsorption.

Laboratory: experimental works and demonstrations concerning practical applications of theory presented during the lectures.

20. Examination: yes

21. Primary sources:

Kirk–Othmer Encyclopedia of Chemical Technology, 4th Ed., Wiley – Interscience, New York (1991).
McKetta J.J., Ed., Unit Operations Handbook, Marcel Dekker, New York (1993).
Smith J.C., Ed., Unit Operations of Chemical Engineering, McGraw-Hill Education – Europe (2000).

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22. Secondary sources:

Perry R.H., Green D.W., Ed., J. Perry's Chemical Engineering Handbook, McGraw-Hill, 7th Ed. (1997).
Harriott P., Unit Operations of Chemical Engineering (McGraw-Hill Chemical Engineering Series) McGraw-Hill (1985, 1993, 2000, 2004).

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/30
2	Classes	-/-
3	Laboratory	30/20
4	Project	-/-
5	BA/ MA Seminar	-/-
6	Other	-/10
	Total number of hours	60/60

24. Total hours: 120

25. Number of ECTS credits: 4

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1

26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*