(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: UNIT OPERATIONS	**2. Course code**
3. Validity of course description: 2017/2018	
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: 5	
10. Faculty teaching the course: Department of Chemical Engineering and Process Design RCh-3	
11. Course instructor: Janusz Wójcik, 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 chosen unit operations, as well as utilize the results in laboratory or industrial practice	examination, credit test	lecture, tutorials, design	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 solving practical problems	examination, credit test	lecture, tutorials, design	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, tutorials, design	K_U01+
5.	Student uses properly matched unit operations and their parameters for the given problem	examination, credit test	lecture, tutorials, design	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, tutorials, design, consultation	K_K01+

18. Teaching modes and hours

Lecture: 45 h / tutorials, 30 h, design 15 h

19. Syllabus description:

Lecture:

Hydraulics of the packed columns – types of packings, parameters of the packed bed, models of the packed bed: granular and capillary, pressure drop of the gas flowing across dry and wet bed, flooding point, optimal velocity of a gas, liquid hold-up.

Falling of solid particles in fluids (sedimentation) - free settling of particles, drag coefficient; hindered settling – types of suspensions, settling of monodisperse suspensions: modified Stokes equation, *Richardson-Zaki's* method, *Happel's* cellular model, settling of polydisperse suspensions: sedimentation curve and its transformations, *Kynch* theory; continuous sedimentation: calculation of thickener area and depth.

Filtration – differential equation of batch filtration, types of filtration cakes, filtration at constant pressure drop or constant flow rate, filtration at changeable pressure drop and flow rate, washing of filtration cake, preliminary selection of a filter, continuous filtration: drum and belt filters, types of cake removing.

Fluidization – critical velocity of gas, types of fluidization, aerodynamic states of the fluidized bed, *Geldart's* classification map of powder materials.

Dedusting of gas in a cyclone – geometric ratios and configuration coefficient of a cyclone, diameter of boundary particle, dedusting efficiency, pressure drop in a cyclone, designing procedure of a cyclone.

Mixing – types of mixing, mechanical agitators and guides to their selection, power consumption for mixing, *Rushton's* graph and standard mixing units, influence of liquid properties on mixing, index of mixing, mixing effectiveness.

tutorials: concerning applications of theory presented during the lectures.

design: gas-gas Heat exchanger

20. Examination: yes

21. Primary sources:

J.M. Coulson, J.F. Richardson, ***Chemical Engineering***, vol.1-6, Pergamon Press, Oxford, 1977.
L.G. Gibilaro, ***Fluidization-dynamics***, Butterworth-Heinemann, Oxford, 2001.
Pomoce projektowe. Operacje jednostkowe. Pod red. Jerzego Raczka. Wyd.2.
Gliwice : Wydaw. Politechniki Śląskiej, 2015
M. Palica, A.Gierczycki, M. Lemanowicz: ***Operacje inżynierii chemicznej***, Wyd. Pol. Śl., Gliwice 2013

22. Secondary sources:

F. A. Holland, R. Bragg***, Fluid Flow for Chemical Engineers,*** Arnold, a division of Hodder Headline PLC, 1995.
R.B. Bird, W. E. Steward, E.N. Lightfoot, ***Transport Phenomena***, Wiley & Sons, NY 2002.
J. R. Welty, C.E. Wicks, R.E. Wilson, ***Fundamentals of Momentum, Heat and Mass Transfer***, Wiley & Sons, NY 1984.
W.L. McCabe, J.C. Smith, ***Unit operations of Chemical Engineering***, Mc Grow Hill, NY 1976.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	45/-
2	Classes	30/30
3	Laboratory	-/-
4	Design	15/20
5	BA/ MA Seminar	-/-
6	Other	-/10
	Total number of hours	90/60

24. Total hours: 150

25. Number of ECTS credits: 5

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)*