STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Process Kinetics	

Field of study	Profile of study (general academic, practical)	Year /Semester
Chemical and Process Engineering	**general academic**	**3/6**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **30** Classes: **-** Laboratory: **45** Project/seminars: **15**	**5**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
basic	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**5 100%**
technical sciences	**5 100%**

Responsible for subject:

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Responsible for lecturer:

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student knows the basics of mathematical analysis, chemistry and physics. Student knows the construction of chemical equipment Student knows the rules for the selection of materials used in the construction of chemical equipment
2	**Skills**	Student has the skills to perform the technical documentation (including engineering drawing). Student has the skills to use of the literature, databases and engineering standards necessary to perform design calculations.
3	**Social competencies**	Student knows the limitations of her/his knowledge and foresees the need for the continuous development.

Assumptions and objectives of the course:

Obtaining knowledge in the field of kinetics of heat and mass transfer processes.
Development of skills of perform process calculations of heat and mass transfer exchangers.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student knows the fundamentals of kinetics of heat and mass transfer – [K_W10]
2. Student has a well-organized general and specific knowledge in the field of chemical engineering – [K_W13]
3. Student knows basic methods, techniques and tools used to solve simple engineering tasks related to chemical engineering – [K_W15]

Skills:

1. Student can acquire information from literature, databases and other sources related to chemical and process engineering, also in a foreign language, integrate them, interpret, draw conclusions and formulate opinions - [K_U01]
2. Student can plan and conduct simple experiments in chemical and process engineering, interpret their results and draw conclusions - [K_U08]
3. Student can identify basic heat and mass processes and formulate their specifications - [K_U17]
4. Student can design heat and mass transfer operations and choose the appropriate equipment for solving simple engineering tasks - - [K_U19] [K_U21]

Social competencies:

1. Student is aware of the responsibility for her/his own work and the willingness to subordinate teamwork and take responsibility for jointly accomplished tasks – [K_K04]

Assessment methods of study outcomes

Knowledge:
Point 1-3: Written exam
Skills:
Point 1-3: Written test and discussion about the realization of laboratory exercises
Point 3: Assessment of reports from laboratory exercises
Point 4: Design of heat exchanger in team
Social competencies:
Point 1: Defence of the heat exchanger project made in team

Course description

Course covers the following topics:

1. Mechanisms of heat transfer
2. Thermal conduction
3. Overall heat transfer coefficient
4. Thermal insulation, calculation of heat loss, critical thickness of insulation
5. Forced convection in heat transfer
6. Falling film on a vertical flat plate
7. Heat transfer in a falling film
8. Heat transfer during condensation of steam
9. Natural convection in heat transfer
10. Mixed-convection in heat transfer
11. Heat transfer in boiling
12. Mass transfer mechanisms
13. Equilibrium between gas and liquid phases
14. Diffusion in the gaseous phase (diffusion of one component through an inert multi-component mixture, equimolar counterdiffusion)
15. Diffusion in the liquid phase
16. Mass transfer in forced turbulent flow (flow in pipe, flow through a packed bed)
17. Mass transfer in falling liquid films on a vertical flat plate
18. Mass transfer in the downward liquid flow through packing
19. Mass transfer between phases
20. Absorption accompanied by chemical reaction
21. Plate efficiency

Basic bibliography:

1. Zarzycki R.: Wymiana ciepła i ruch masy w inżynierii środowiska, WNT, Warszawa 2005.
2. Wiśniewski S., Wiśniewski T.S., Wymiana ciepła, WNT, Warszawa 2012.
3. Hobler T.: Dyfuzyjny ruch masy i absorbery, WNT, Warszawa 1976.
4. Hobler T.: Ruch ciepła i wymienniki, WNT, Warszawa 1986.
5. Koch R., Kozioł A., Dyfuzyjno-cieplny rozdział substancji, WNT, Warszawa 1994.
6. Broniarz-Press L. i inni: Inżynieria chemiczna i procesowa. Laboratorium, Wydawnictwo Politechniki Poznańskiej, Poznań 2000.
7. Palica M., Gierczycki A., Lemanowicz M., Operacje inżynierii chemicznej, część 1 i 2, Wydawnictwo Politechniki Śląskiej, Gliwice 2013.
8. Broniarz-Press L. i inni: Inżynieria Chemiczna i Procesowa. Materiały Pomocnicze. Części II-III. Wydawnictwo Politechniki Poznańskiej, Poznań 1999-2005.
9. Oleśkowicz-Popiel C., Wojtkowiak J.: Eksperymenty w wymianie ciepła, Politechniki Poznańskiej, Poznań 2004.
10. Troniewski L.: Hoblerowskie ujęcie ruchu masy, Wydawnictwo WSI, Opole 1996.

Additional bibliography:

1. Broniarz-Press L.: Hydrodynamika spływu filmowego cieczy i zjawiska przenoszenia w aparatach warstewkowych, Wydawnictwo Politechniki Poznańskiej, Poznań 2004.
2. Coulson J.M., Richardson J.F.: Chemical Engineering, vol. I-VI, Butterworth Heinemann, Oxford 1999-2002.
3. Danckwerts P.V.: Gas-Liquid Reactions, McGraw Hill Book Comp., New York 1970.
4. Plawsky J.L.: Transport Phenomena Fundamentals, Dekker, New York 2001.
5. Pohorecki R., Wroński S.: Termodynamika i kinetyka procesów inżynierii chemicznej, WNT, Warszawa 1977.
6. Bandrowski J., Gierczycki A., Thullie J.: Przykłady i zadania z dyfuzyjnego transportu masy, Wydawnictwo Politechniki Śląskiej, Gliwice 2001.
7. Bińa A. i inni: Zadania projektowe z inżynierii procesowej, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2002.

Result of average student's workload

Activity	Time (working hours)

1. Lectures	30
2. Preparation for exam	9
3. Exam	3
4. Preparation for tests	3
5. Preparation for laboratories, including the preparation of reports	6
6. Participation in laboratory exercises	45
7. Project classes	15
8. Project preparation of the heat exchanger design	7
9. Consultations	7

Student's workload

Source of workload	hours	ECTS
Total workload	125	5
Contact hours	100	4
Practical activities	70	2,5