# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Process kinetics [S1IChiP1>KP]

## Course

Field of study
Chemical and Process Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
30

Laboratory classes
45

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

## Number of credit points

5,00

## Coordinators

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## Lecturers

## Prerequisites

Students starting this subject should have basic knowledge in mathematics, physics, chemistry, statistics, engineering graphics, fluid mechanics and materials technology. They should also have the ability to use spreadsheets, performing statistical analysis of measurement results and be ready to work in a team.

## Course objective

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.

## Course-related learning outcomes

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 competences:
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]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Knowledge acquired during the lecture is verified during the exam. The exam consists of 5 open questions for the same number of points. Minimum threshold: 51% points Exam issues, on the basis of which questions are formed, will be sent to students by e-mail using the university e-mail system. The online exam will be conducted on the same terms via the eMeeting platform or another platform recommended by the Poznań University of Technology.
Skills and knowledge acquired as part of the laboratory work are verified on a daily basis based on oral answers and 1 final test, consisting of 3-6 questions for the same number of points. To pass the laboratory you must:
1. Provide an oral answer from the material contained in the exercises and from the given issues (each failing grade must be corrected to a positive).
2. Perform all laboratory exercises provided in the study program
3. Get passes for reports on the exercises performed.
4. Pass the colloquium: three open-ended questions (pass: 51% points)
5. The final grade will be issued on the basis of:
a) the arithmetic mean of all grades obtained from oral responses,
b) the arithmetic mean of all the grades obtained in the tests.
The arithmetic means calculated in this way will be divided by two and the final grade will be issued according to a scale: up to 2.74 - unsatisfactory; from 2.75 to 3.24 - sufficient; from 3.25 to 3.74 - a sufficient plus; from 3.75 to 4.24 - good; from 4.25 to 4.74 - a good plus; from 4.75 - very good.
Passing the laboratory will be in an online form, carried out on the same terms via the eMeeting platform or another platform recommended by the Poznań University of Technology.
The skills acquired during the project classes are verified on the basis of the documentation of the heat exchanger design and the defense of the project. The final grade is based on the arithmetic mean calculated from all the grades obtained (up to 2.74 - unsatisfactory; from 2.75 to 3.24 - sufficient; from 3.25 to 3.74 - a sufficient plus; from 3.75 to 4.24 - good; from 4.25 to 4.74 - a good plus; from 4.75 - very good). Examination will be in an online form on the same terms via the eMeeting platform or another platform recommended by the Poznań University of Technology.

## Programme content

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

## Course topics

none

## Teaching methods

1. Lecture: multimedia presentation, illustrated with examples on the board.
2. Laboratory exercises: performing experiments related to heat, mass and momentum transfer processes.
3. Project: multimedia presentation, illustrated with tasks solved on the board.

## Bibliography

Basic
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.
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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
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. Biń A. i inni: Zadania projektowe z inżynierii procesowej, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2002.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 125 | 5,00 |
| Classes requiring direct contact with the teacher | 100 | 4,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 25 | 1,00 |