FACULTY OF CHEMISTRY

**SUBJECT CARD**

Name of subject in English: Physico-chemical bases of process engineering
Main field of study (if applicable): Chemical and Process Engineering
Specialization (if applicable):
Profile: academic
Level and form of studies: 1st level, full-time
Kind of subject: obligatory
Subject code:
Group of courses: NO

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---|---|---|---|---|
| Number of hours of organized classes in University (ZZU) | 30 | 30 | 30 | | |
| Number of hours of total student workload (CNPS) | 90 | 60 | 60 | | |
| Form of crediting | Exam | crediting with grade | crediting with grade | | |
| For group of courses mark (X) final course | | | | | |
| Number of ECTS points | 3 | 2 | 2 | | |
| including number of ECTS points for practical (P) classes | | 2 | 2 | | |
| including number of ECTS points for direct teacher-student contact (BU) classes | 1,3 | 1,4 | 1,4 | | |

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Calculations of derivatives and integrals
2. Understanding of basic physics laws and knowledge of bases of physical chemistry which are important for modeling of processes in chemical engineering

**SUBJECT OBJECTIVES**

C1 To obtain knowledge about basic ideas and methods of physical chemistry

**SUBJECT LEARNING OUTCOMES**

**related to knowledge:**

The person who completed the course:

PEK_W01 – is familiar with the essential notions of thermodynamics, particularly in the context of thermodynamic transformations

PEK_W02 – is familiar with the essential notions of equilibrium of chemical reactions

PEK_W03 - is familiar with the methods of thermodynamic characterization of pure and mixed system using the phase diagrams

PEK_W04 - is familiar with the essential notions of phase transitions

PEK_W05 – knows the way of characterization of pure substances

PEK_W06 – knows the idea and the goal of distinction between ideal and real systems

PEK_W07 –can apply ideas and calculations methods of physical chemistry for qualitatively description of

thermodynamics and kinetics chemical processes

**related to skills:**
The person who completed the course:

PEK_U01 – is able to calculate properties of pure and mixed systems using the equation of state

PEK_U02 - is able to solve problems related to phase equilibria

PEK_U03 - is able to determine the thermodynamic properties

PEK_U04 – is able to design experiments to determine phase equilibrium

PEK_U05 – is able to conduct the experiments, to interpret the obtained results and state the conclusions

**related to social competences:**
The person who completed the course:

PEK_K01 – is able to cooperate and work with the others in one team

**PROGRAMME CONTENT**

| **Lectures** | | **Number of hours** |
|---|---|---|
| Lec 1 | Introduction to the topic of the lecture. Basic thermodynamic definitions | 2 |
| Lec 2 | Thermodynamic equilibrium of chemical reactions | 6 |
| Lec 3 | Equations of state | 2 |
| Lec 4 | Equations of Van der Waals type | 2 |
| Lec 5 | Ideal and real solutions. Notion of fugacity | 4 |
| Lec 6 | Special cases of phase equilibria: distillation, absorption, extraction | 4 |
| Lec 7 | Chemical kinetics and reactors | 6 |
| Lec 8 | Calculations problems in chemical engineering and technology | 4 |
| | | 30 |

| **Classes** | | **Number of hours** |
|---|---|---|
| Proj 1 | Introduction and methodology | 2 |
| Proj 2 | Problems related to equation of state | 6 |
| Proj 3 | Partial exam1 | 2 |
| Proj 4 | Problems related to thermodynamic properties of pure systems | 6 |
| Proj 5 | Problems related to thermodynamic properties of solutions | 6 |
| Proj 6 | Problems related to phase equilibria in multicomponent systems | 4 |
| Proj 7 | Partial exam 2 | 2 |
| Proj 8 | Final exam | 2 |
| | | 30 |

| **Laboratory** | | **Number of hours** |
|---|---|---|
| Proj 1 | Basic rules of work in laboratory. Orderliness of the classes. | 2 |
| Proj 2 | Laboratory exercises of determination of the basic thermodynamic parameters | 8 |
| Proj 3 | Laboratory exercises of diffusivity processes | 4 |

| | | |
|---|---|---|
| Proj 4 | Laboratory exercises of heat transfer processes. | 8 |
| Proj 5 | Laboratory exercises of phase equilibria processes | 8 |
| | | 30 |

**TEACHING TOOLS USED**

N1. Academic lecture
N2. Problem sessions
N3. Laboratory experiment

**EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT**

| **Evaluation** (F – forming (during semester), P – concluding (at semester end) | Learning outcomes number | Way of evaluating learning outcomes achievement |
|---|---|---|
| F1 (classes) | PEK_U01 | Partial evaluation 1 (max. 100 pts.) |
| F2 (classes) | PEK_U02-PEK_U03 | Partial evaluation 2 (max. 100 pts.) |
| P (laboratory) | PEK_U05; PEK_K01 | Activity during the sessions |
| P (lecture) | PEK_W01-PEK_W07 | Final exam |

Grade:
P (classes) =
3,0 jeżeli (F1 + F2) = 100 – 120 pts.
3,5 jeżeli (F1 + F2) = 121 – 140 pts.
4,0 jeżeli (F1 + F2) = 141 – 160 pts.
4,5 jeżeli (F1 + F2) = 161 – 180 pts.
5,0 jeżeli (F1 + F2) = 181 – 200 pts.
5,5 jeżeli (F1 + F2) = 201 – pkt.

**PRIMARY AND SECONDARY LITERATURE**

**PRIMARY LITERATURE:**

[1] K. Pigoń, Z. Róziewicz, Chemia Fizyczna Tom 1. PWN, Warszawa 2019
[2] J. Szargut, Termodynamika, PWN, Warszawa 2019
[3] J. M. Smith, H. C. Van Ness, M. M. Abbot, Introduction to Chemical Engineering Thermodynamics, MCGraw Hill, Boston 2001

**SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)**

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