Detailed course description
(SUBJECT CARD)

Course title: REACTORS and REACTION ENGINEERING
Course code:
Affiliation to a course group:
Course type: general
obligatory
Field of study:
Level of study: second-cycle programme
Study profile: general academic
Mode of study: full-time programme
Specialty (specialisation): Nanomaterials and Fine Chemicals; Process Engineering for Green Chemical Technologies
Year of study:1
Semester: 1
Teaching modes and teaching hours:
lectures – 30;
tutorials – 15;
Language/s of instruction: English
Number of ECTS credits *(according to the study programme)***:3**
** – leave the appropriate option*

1. Course objectives:

An objective of the course is to acquaint students with basic methods of catalytic reactors calculations

2. Relating the field-specific learning outcomes to teaching modes, verification methods and assessment of student's learning outcomes:

symbol	assumed learning outcomes *a student who completed the course:*	teaching modes	verification methods and learning outcome assessment
Knowledge: a student knows and understands			
1	**effective diffusivity of gases through the catalyst pores by accounting for molecular diffusivity, Knudsen diffusivity, porosity, and tortuosity of the catalyst pellet.**	lecture	Examination
2	**overall rate of a catalytic reaction with both external mass transfer and internal pore diffusion**	lecture	Examination
3	**Thiele modulus and effectiveness factor in determining the rate-limiting regimed pore diffusion versus reaction.**	lecture	Examination
4	**performance equations for reactors containing porous catalyst particles (plug flow, mixed flow, batch of catalyst)**	lecture	Examination
5	**Ely-Reidel and Langmuir-Hinshelwood mechanisms for surface reactions**	lecture	Examination
6	**staged adiabatic packed bed reactors (exothermic reactions in staged reactors, choice of contacting system – plug flow, mixed flow, cold shot cooling)**	lecture	Examination
Skills: a student can			
1	calculate **effective diffusivity of gases through the catalyst pores**	Classes	Credit test
2	calculate **overall rate of a catalytic reaction**	Classes	Credit test
3	**Estimate Thiele modulus and effectiveness factor**	Classes	Credit test
4	**use performance equations for reactors containing porous catalyst particles (plug flow, mixed flow, batch of catalyst)**	Classes	Credit test
Social competences: a student is able to			
1	**Describe steps in a heterogeneous catalytic reaction**	Lecture + classes	Examination + test
2	Present **modification of rate equation for heterogeneous catalysis**	Lecture + classes	Examination + test
3	**Choose suitable performance equations for different reactors containing porous catalyst particles**	Lecture + classes	Examination + test

3. Study programme contents ensuring the learning outcomes *(according to the study programme)*:
4. Description of methods to determine the ECTS credits:

Type of activity	Number of hours / ECTS credits
Number of course hours regardless of a teaching mode	45/2
Student workload 1: Preparation for the course	30/0.75
Student workload 2: Preparation for the examination	15/0.25
Student workload n*	
Consultation, exam	10
Total hours:	**100**
Number of ECTS credits allocated for a course	**3**

Description:
* – student workload, types of activities need to be provided, e.g. preparation for the course, interpretation of results, preparation of a course report, preparation for the examination, getting familiar with the literature, preparation of a project, presentation, written work, report, etc.
** – other e.g. additional course hours

5. Summary indicators:
   - number of course hours and ECTS credits at the course with a direct participation of academic teachers or other persons teaching the course and students: 2
   - number of course hours and ECTS credits at the course related to the scientific activity conducted at the Silesian University of Technology in a discipline or in disciplines to which a field of study is assigned- in the case of studies with a general academic profile:
   - number of course hours and ECTS credits at the course shaping practical skills- in the case of practical studies: 1
   - number of course hours conducted by academic teachers employed by the Silesian University of Technology as their primary workplace:
6. Persons conducting particular types of courses (name, surname, academic degree or degree in arts, title of professor, business e-mail address):

   dr inż. Wojciech Pudło; wojciech.pudlo@polsl.pl

7. Detailed description of teaching modes:

   1) lectures:
      - detailed programme contents:

   Catalyst and characterization; definitions and catalyst properties. Kinetics of catalytic reactions; Surface reactions; Mechanisms and kinetic models; Synthesizing a rate law. Heterogeneous data analysis for reactor design; Catalyst deactivation. External diffusion effects in heterogeneous reactions. Diffusion and reaction in porous catalysts; Spherical catalyst pellets; Internal and external transport processes; Internal effectiveness factor; overall effectiveness factor. Heat and Mass transfer and reaction in a packed bed; Conservation equations and simplifications; Autothermic reactors.

      - teaching methods, including distant learning:

        Presentation and discussion with students.

      - form and criteria for successful semester completion, including retakes, as well as the conditions for admission to the examination:

        Completion of the lecture is based on a positive evaluation of the test. A condition for a positive assessment is to obtain a minimum of 55% from 100 % obtainable. Improvement of the test is possible twice.

      - course organisation and rules of participation in the course, with an indication whether a student ‘s attendance is obligatory

        Attending lecture classes is not obligatory

   2) description of other teaching methods:

      Solving problems dictated by the teacher during classes (problems are related to lectures)

8. Description of the method to determine the final grade (rules and criteria for evaluation, as well as a calculation method for the evaluation in the case of a course which includes more than one teaching mode, including all teaching modes and all examination and credit dates including retake examinations):

   The final grade of the subject is the value of the arithmetic average of the grade of the lecture and grade of tutorials.

9. Method and procedure for filling up arrears resulting from:

   - student's absence from the course,

   Depending on the form of absence, it is determined by the lecturer during consultations in accordance with the forms of conducting classes and the conditions for getting credit set out in point 7 of this card

   - differences in study programmes for persons changing a field of study, changing university or resuming studies at the Silesian University of Technology,

   .....

10. Prerequisites and additional requirements, taking into account the course sequence:

    basic knowledge of Mathematics, Unit Operations and Fluid Mechanics, Reactors and Reaction Engineering Ist.

11. Recommended sources and teaching aids:

    - R. Aris, Elementary Chemical Reactor Analysis, Dover Publications 1989.
    - O. Levenspiel, Chemical Reaction Engineering, John Wiley, 1962

12. Description of teacher's competences (e.g. publications, professional experience, certificates, trainings etc. related to the programme contents implemented as part of the course):

    Wojciech Pudło, PhD Eng in Chemical Engineering, specialization in micro-reactors.

    PhD thesis: Synthesis and properties of porous oxide monoliths for the application in micro-reactors

13. Other information:
    None