# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Application of computer tools in design practice [S2TCh2-PTiB>ZNKwPP]

## Course

Field of study
Chemical Technology

Year/Semester
2/3

Area of study (specialization)
Technological Processes and Bioprocesses

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
0

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
30

## Number of credit points

2,00

## Coordinators

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## Lecturers

## Prerequisites

Student has knowledge of mathematics to the extent that it can use mathematical methods to describe chemical processes and perform calculations needed in engineering practice. Student has basic knowledge related to the selection of materials used in the construction of chemical apparatus and installations. Student has basic level knowledge of operating any CAD program.

## Course objective

The purpose of the course is to learn how to design apparatus and equipment using the finite element method (FEM). The project provides an opportunity to get acquainted with the design flow carried out according to the assumptions of the DBA (design by analysis) approach and thus gives the opportunity to compare this flow with the classical DBF (design by formula) approach. An important aspect of the subject is the use of the CAD design aid tool Ansys/Mechanical.

## Course-related learning outcomes

Knowledge:
The student acquires knowledge in the area of chemical apparatus design, application of computational models and consideration of different levels of complexity in the design. The student understands the

necessity of numerical procedures and their significant impact on the way calculations are carried out. (K_W01, K_W03, K_W06, K_W07)

Skills:
The student is able to select an appropriate computational approach depending on the given design problem. In doing so, he/she is also able to consider the importance of available computing power and take it into account as an important factor limiting some aspects of the design flow. The student is able to create geometries in 2D and 3D space. He/she is able to select an appropriate technique for creating computational meshes. The student is able to define the loading conditions of the device, such as temperature, pressure, concentrated and distributed forces. The student is able to define appropriate types of contacts between solids. The student knows how to evaluate the obtained results according to the analysis of the stress field, strain field and stress energy field. (K_U01, K_U06, K_U07, K_U14)

Social competences:
The student is aware of the possibilities inherent in modern computer techniques in the positive sense, i.e. in the possibility of precise design optimization. He is also aware of the social significance in the negative sense, i.e. in the possibility of conducting design in such a way as to use the potential of computer techniques for optimization in order to actually shorten the life of the product. The student is aware that this type of activity is socially unethical and irresponsible. (K_K02)

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Semester evaluation of the completed project, which consists of a preliminary pre-project analysis, the quality of the completed project and the preparation of a final report.
In the case of the classroom version of the course, the assessment is carried out in the computer lab, while in the case of online classes, the assessment is carried out using the university's network-computer infrastructure (VPN) through the Remote Desktop Protocol (RDP) using the remote desktop connection tool.

## Programme content

Discussion of TRL technology readiness levels and the location of the design stage in question within them. Recall of basic definitions related to the properties of materials under mechanical load. Defining assumptions and design objectives. Creation of the model in the selected version of the space. Generating the calculation mesh. Selecting a deformation model. Declaring mechanical and thermal loading conditions. Influence and selection of numerical parameters. Methods for evaluating the results obtained from FEM analysis.

## Teaching methods

A comprehensive presentation of how the Ansys/Mechanical tool works. A detailed overview of the various techniques available in the Ansys software suite in terms of mechanical calculations. Presentation of the use of the so-called design point in the cross-sectional analysis of loads and the selection of selected dimensions of apparatus in a given process. Based on the presented examples, students make preliminary test designs of single simulation calculations during the class. The teacher assists students at this stage in the area of use of the CAD tool, without solving the assigned design problems.
During the implementation of the target semester project, students are assisted in the operation of Ansys platform programs, but independently make design decisions for which they are responsible. All solutions regarding geometry, use of materials, selection of loads, computational settings and analysis of results are within the students' area of initiative and responsibility.

## Bibliography

Basic:
Finite Element Analysis: Theory and Application with ANSYS, Saeed Moaveni, Pearson, 2007
An Introduction to the Finite Element Method, J.N. Reddy, McGraw-Hill, 2005

Additional:
Zienkiewicz O.C., Taylor R.L., Zhu J.Z.: The finite element method: Its basis and fundamentals, Elsevier,

2013.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 50 | 2,00 |
| Classes requiring direct contact with the teacher | 30 | 1,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 20 | 1,00 |