

International Study Program 2025: Innovation and Sustainability in Engineering and Environmental Planning

Course 2: Design of Experiments Workshop DOE – powerful tool for analyses and optimisation of industrial series production processes

Program description

The intensive, interdisciplinary International Study Program explores the topic of “Sustainability and Innovation in Engineering and Environmental Planning”. The program consists of three parts. Course 1 surveys recent technological developments in four smaller units dedicated to different research areas: Energy, E-Mobility, Agriculture and Materials. In Course 2, students complete a hands-on workshop on DOE methods for analyzing and optimizing production processes in the industry (engineering). The accompanying cultural module “Living Society” contextualizes the innovation trends explored in Courses 1 and 2 in terms of German culture and history.

Through lab and project work, theoretical input, discussion and company visits, students gain a comprehensive view of innovation processes aimed at sustainability. The program is designed for students from various engineering and planning fields. In this international program, visiting and local students participate together, enabling intercultural exchange and offering an unforgettable experience abroad.

Course content

This workshop teaches the basics and examples of analyzing and optimizing industrial production processes by DOE methods. These methods have become popular in the industry and are a powerful tool in modern quality management, e.g. in Six Sigma quality programs worldwide. In the one week workshop the students learn the application of DOE in two exemplary processes, the injection molding process and the modification of plastic surfaces.

The project week include basics of the processes and the DOE methods, practical experiments, measurement data analyses and interpretation. The results are finally presented.

Competence goals

Students who have successfully completed the course have a basic understanding of real world scientific industrial research and will be able to discuss current methods and developments within the field in oral and written form. Besides an increase in competences such as working in international teams and conducting applied research projects, participants will gain the following knowledge and skills:

Knowledge:

- state of knowledge and experience in using DOE methods for analyzing and optimizing industrial processes
- background information on the general process technology in molding and surface modification

Skills (conceptual + practical):

- developing an experimental DOE design for qualitative and quantitative studies
- application of DOE on real processes (molding, surface treatment)
- analyzing, visualizing and interpretation of the experimental DOE data results
- preparing and performing scientific result presentations

Methods

Lectures, real experiments on industrial processes, DOE and application, data analyses and process optimization, presentation of results

Prerequisites

Basic knowledge in research methods and industrial processing, quick comprehension of new knowledge and to apply this instantaneously. Other prerequisites (or at least the will to learn it) are adequate character traits and a smart and flexible interpersonal skills to deal with participants in real industrial situations. CAD, video editing software and MS Excel are desirable but not mandatory.

Lecturers

Prof. Rainer Bourdon,
Marius Behnecke

Literature for Further Reading

- Suhas Kulkarni: Robust Process Development and Scientific Molding – Theory and Practice, Hanser Publications, 2017
- Gerd Pötsch, Walter Michaeli: Injection Molding – an introduction, Hanser Publications, 2007
- Jiju Antony: Design of Experiments for Engineers and Scientists (2nd Edition), Elsevier 2014
- Wilhelm Kleppmann: Versuchsplanung, Hanser, 2011
- Rainer Bourdon et. Al.: Standardized optimization of process and quality by DOE methods – a short manual for injection molding in practice, Journal of Plastics technology, 2012

Exam and grading

The basis for grading is as follows:

- Comprehensive workshop report and/or presentation (80 %)
- Additional interdisciplinary assessed assignment in the course of the program (20%)

Prerequisite for grading is an individual active participation and engagement with course content.

Duration

02.06.-06.06.2025

1 Day introduction to the processes of molding, surface modification

1 Day introduction to the DOE methods

2 Days practical experimental work, measuring and analyses

1 Day final presentations

Frequency

Yearly

Course Language

English