Lodz University of Technology

Instrumental Methods of Quality Control

Course description

Basic information

Study programme Industrial Process Engineering **Speciality/path** - **Organizational unit** Faculty of Process and Environmental Engineering **Study level** first-cycle programme (inżynier) **Study mode** full-time studies **Education profile** general academic	**Didactic cycle** 2026/27 **Course code** **Language of instruction** English **Obligatory** Optional **Block** Directional subjects **Course related to scientific research** Yes

Course coordinator	Anna Rył
Course instructor(s)	Anna Rył

Period Semester 7	**Form of verification** Graded assignment **Classes and hours** • Lecture: 15 • Seminar: 10 • Laboratory classes: 20	**Total ECTS points** 3

Prerequisites

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Learning outcomes

Code	Programme outcomes	Detailed outcomes indicators
1IPP2	Has knowledge of key chemical and process engineering processes, including: (1) momentum, heat and mass exchange mechanisms and their application in unit operations and process apparatus; (2) principles of mass, energy and momentum balancing in process engineering processes; (3) product separation, separation and purification processes; (4) fundamentals of chemical and biochemical reaction engineering.	1IPP2.1 Explain the mechanisms of momentum, heat and mass exchange and describe their role in basic unit operations and process apparatus.
1IPP4	Applies analytical and critical thinking to identify, formulate, and solve complex and atypical engineering problems related to industrial processes and process installations, selecting appropriate computational, technological, and organisational methods.	1IPP4.3 Analyses and compares alternative process options, identifying their benefits, limitations and impact on plant operation.
1IPP7	Presents various technical concepts, design proposals, and results of analyses and studies in a clear and structured manner, preparing technical reports and presentations adapted to diverse audiences — including engineering teams, stakeholders, and non-technical recipients, participating in a debate — and communicates in a foreign language at the B2 level, using basic engineering terminology.	1IPP7.5 Independently develops a coherent and structured presentation or project or research report - also in a foreign language at B2 level - integrating data, analytical results and conclusions in a way that is understandable to technical and non-technical audiences.

Course contents

Fundamentals of instrumental quality control methods applied to the analysis of raw materials, intermediates, and finished products. The course introduces the selection and interpretation of analytical techniques used for monitoring and improving industrial processes.

Complementary information

Contents - detailed selection

No.	Contents - detailed selection	Class type
1.	Role of instrumental methods in quality control (QC); Quality control vs quality assurance – objectives and scope; Quality attributes and quality indicators in industrial products; Physical basis of instrumental measurements in QC; Transport phenomena (momentum, mass transfer) as the basis of selected instrumental methods; Principles and applicability of instrumental methods used in QC: spectrophotometric methods, chromatographic methods, optical methods, and rheological methods; Instrumental assessment of structure-related quality attributes; Physical stability of products and dispersed systems – mechanisms and indicators; Accelerated aging tests and shelf-life assessment; In-line, at-line and off-line measurements in quality monitoring; Interpretation of instrumental data for quality control purposes: variability and repeatability, trends and degradation patterns, and acceptance criteria and quality limits; Limitations of instrumental methods and sources of uncertainty in QC measurements	Lecture
2.	Laboratory classes focus on the practical application of instrumental methods used in quality control of industrial products. Students perform selected measurements using instrumental techniques commonly applied to assess quality-related attributes such as flow behaviour, structure, texture and physical stability. During laboratory exercises, students identify key quality attributes of the analysed systems, select appropriate measurement methods, and evaluate the relevance of the obtained data for quality control purposes. Emphasis is placed on the interpretation of experimental results, comparison of samples or variants, and assessment of method suitability and limitations in the context of quality monitoring. Laboratory work develops students' ability to analyse instrumental data, recognise sources of variability and uncertainty, and formulate conclusions supporting quality-related decisions.	Laboratory classes
3.	The seminar complements the lecture and laboratory classes by focusing on the critical analysis of instrumental methods applied in quality control. Students prepare and deliver presentations based on selected scientific publications or case studies related to quality assessment in the food, pharmaceutical or cosmetic industries. Seminar activities emphasise the interpretation of instrumental results, comparison of alternative analytical approaches, and discussion of the advantages and limitations of different methods from a quality control perspective. Particular attention is paid to the clear and structured presentation of data, results and conclusions, including communication in English at the B2 level. The seminar fosters critical thinking, technical discussion and the ability to communicate quality-related findings to both technical and non-technical audiences.	Seminar

Teaching methods and techniques, passing conditions

Class type	Teaching methods and techniques	Passing conditions
Lecture	Flipped classroom	To pass the lecture component, the student is required to: • obtain at least 50% of the total points from short tests/quizzes conducted during the course, • demonstrate basic engagement during lectures, including participation in discussions and flipped-classroom activities, assessed through teacher continuous assessment.

Class type	Teaching methods and techniques	Passing conditions
Seminar	Tutoring, Inquiry based learning	To pass the seminar component, the student is required to: • prepare and deliver a multimedia presentation based on a selected scientific publication or case study related to instrumental methods of quality control, • actively participate in seminar discussions, • take part in peer assessment by providing constructive, content-related feedback on other students' presentations. Peer assessment consists of evaluating the quality of presented material with respect to: • clarity of data presentation, • correctness and depth of result interpretation, • relevance of conclusions for quality control practice. The seminar grade is based on the multimedia presentation, peer assessment (quality of feedback and engagement) and teacher continuous assessment.
Laboratory classes	Tutoring, Laboratory/computer-based exercises	To pass the laboratory component, the student is required to: • actively participate in laboratory exercises, • correctly perform assigned measurements and analyse experimental data, • submit laboratory report(s) presenting results and their interpretation in the context of quality control. The laboratory component is passed based on laboratory reports and teacher continuous assessment, including evaluation of student engagement, data interpretation skills and quality of conclusions.

Examination methods, weighed grades

Class type	Examination methods and weighed grades
Lecture	Short test/Quiz: 20% Teacher continuous assessment: 5%
Seminar	Multimedia presentation: 15% Peer-assessment: 10% Teacher continuous assessment: 10%
Laboratory classes	Teacher continuous assessment: 20% Lab report(s): 20%

Verification of learning outcomes

Detailed outcome indicators	Verification criteria	Assesment tool (class type)
1IPP2.1	The learning outcome is considered achieved if the student: • explains the physical basis of selected instrumental methods used in quality control, referring to momentum and/or mass transfer mechanisms, • correctly links the measured instrumental signal with the underlying physical transport phenomena, • interprets examples of instrumental data in relation to quality attributes of industrial products.	Teacher continuous assessment (Lecture, Seminar, Laboratory classes), Short test/Quiz (Lecture)

Detailed outcome indicators	Verification criteria	Assesment tool (class type)
1IPP4.3	The learning outcome is considered achieved if the student: • compares alternative instrumental methods or measurement approaches used for quality control of selected products, • identifies advantages and limitations of instrumental techniques in relation to quality assessment objectives, • analyses experimental or literature data and formulates conclusions supporting quality control decisions.	Multimedia presentation (Seminar), Teacher continuous assessment (Lecture, Seminar, Laboratory classes), Lab report(s) (Laboratory classes), Peer-assessment (Seminar)
1IPP7.5	The learning outcome is considered achieved if the student: • prepares a clear and structured multimedia presentation or laboratory report in English, • correctly presents and interprets instrumental data and analytical results, • formulates coherent conclusions adapted to a technical or non-technical audience, • actively participates in technical discussion using appropriate engineering terminology.	Multimedia presentation (Seminar), Teacher continuous assessment (Lecture, Seminar, Laboratory classes), Lab report(s) (Laboratory classes), Peer-assessment (Seminar)

Literature

Compulsory reading

1. Petrozzi, S. (2012). Practical Instrumental Analysis: Methods, Quality Assurance, and Labora-tory Management. John Wiley & Sons.
2. Kilcast, D. (Ed.). (2013). Instrumental assessment of food sensory quality: A practical guide. Elsevier
3. Carrillo-Cedillo, E. G., Arredondo-Soto, K. C., Palomino-Vizcaino, K., & Magana-Badilla, H. A. (Eds.). (2022). Quality Control Applications in the Pharmaceutical and Medical Device Manufacturing Industry. IGI Global.

Other reference materials

1. Selvamuthu, D., & Das, D. (2018). Introduction to statistical methods, design of experiments and statistical quality control (Vol. 445). Singapore: Springer Singapore.

Research and publications

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Student workload

Activity type	Average number of hours* needed to complete an activity
Lecture	15
Seminar	10
Laboratory classes	20

Preparation for the laboratory	10
Preparation of a multimedia presentation	10
Literature analysis	15
Total student workload	**No. of hours** 80
Workload involving teacher	**No. of hours** 45
Total ECTS points	**ECTS** 3

* activity hour equals to 45 minutes

Directional learning outcomes

Code	Content
1IPP2.1	Explain the mechanisms of momentum, heat and mass exchange and describe their role in basic unit operations and process apparatus.
1IPP4.3	Analyses and compares alternative process options, identifying their benefits, limitations and impact on plant operation.
1IPP7.5	Independently develops a coherent and structured presentation or project or research report - also in a foreign language at B2 level - integrating data, analytical results and conclusions in a way that is understandable to technical and non-technical audiences.