

Course on Advanced Analytical Chemistry and Chromatography

Jens E.T. Andersen and Peter Fristrup

DTU Chemistry, Kemitorvet Building 207, DK-2800 Kgs. Lyngby, Denmark

Kristian Fog Nielsen and Per Hägglund

DTU Systems Biology, Søltofts Plads, Building 221 , DK-2800 Kgs. Lyngby, Denmark

Jens Jørgen Sloth

DTU Food, Mørkhøj Bygade 19, DK-2860 Søborg , Denmark

Katja Jankova

DTU Chemical Engineering, Department of Chemical and Biochemical Engineering, Søltofts Plads, Building 227, DK-2800 Kgs. Lyngby, Denmark

Abstract

Methods of analytical chemistry constitute an integral part of decision making in chemical research, and students must master a high degree of knowledge, in order to perform reliable analysis. At DTU departments of chemistry it was thus decided to develop a course that was attractive to master students of different direction of studies, to ph.d. students and to professionals that need an update of their current state of skills and knowledge. A course of 10 ECTS points was devised with the purpose of introducing students to analytical chemistry and chromatography with the aim of including theory, exercises, presentations, practices and procedures, and reporting. After the course the students are able to perform the tasks of analytical laboratories at the level of laboratory leader. Subjects of quality assurance are difficult to make interesting to the students but in this course exercises are included that encourage students in a competitive manner to demonstrate their laboratory skills under the conditions of method validation. This tutorial procedure proved successful in the sense that students were able to understand and report the results according to standard operations procedures. The students are provided with detailed oral instructions and limited instructions in writing thus allowing them to conceive their own approach to designing the experimental setup in close collaboration with teachers. There are several teachers of different DTU departments affiliated to the course allowing the students to meet the foremost experts of technology in specialized areas of chemical analysis and chromatography. Laboratory exercises are performed at different laboratories that provide access to high-quality apparatus. The students are evaluated by a report of exercises extending to 2½ ECTS and an oral examination in the remaining part of the syllabus covering 7.5 ECTS.

Course Structure

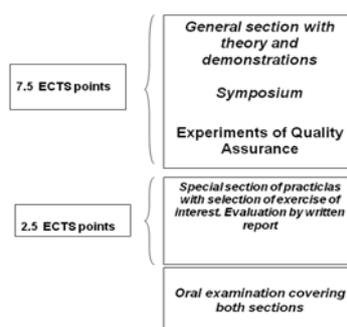


Figure 1. The course on Analysis and Chromatography (DTU 26316) covers 10 points distributed in two main sections. In the first section of theory and problem solving the students are introduced to the theory that allows them to perform presentations at a symposium. In the special section experiments are performed.

Conceive: Based on the section of theory, students may suggest methods of reliable chemical analysis.

Design: Analytical chemistry is characterized by hyphenating several types of apparatus that allows specialized types of analysis. The design of the manifold or experimental setup is important to automation and reliable analysis.

Implement: The experiments are performed in several different laboratories in departments of DTU where the students implement designed methods under the supervision of teachers.

Operate: In order to ensure applicability to real measurements, the students perform several exercises using advanced apparatus that must be subjected to maintenance and safety regulations. The results obtained should be monitored by methods of quality assurance.

In figure is shown an example of results obtained by students performing exercises in part two of the course.

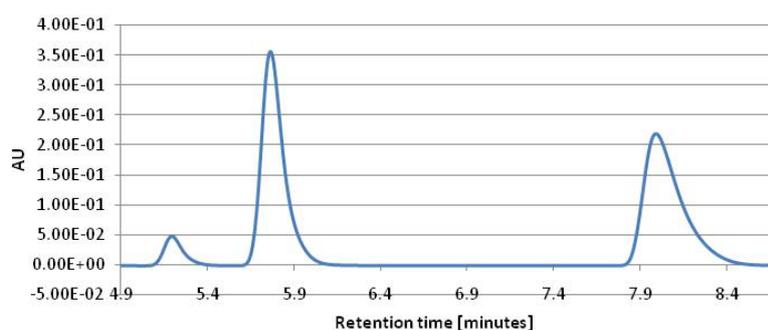


Figure 2. Advanced results obtained by students at course 26316, special section. 5 Isocratic HPLC separation of mixture of R- and S trans-stilbene oxide at 10 mL/min on a 250x4.6 mm Chiralcel OD-H column with 10 vol% 2-propanol and 90 vol% hexane. The PDA detector measured absorbance at 254 nm. First peak: 5.53 area%; second peak: 46.6 area %; third peak: 47.87 area%.

Conclusion

The course was attended by between 40 and 55 students within the first three years of implementation. Almost all the students who attended the final oral examination passed the course. More than 50 % of the students found they learned a lot but found the workload to be relatively high.