252nd American Chemical Society Meeting

Establishing a Safe Workplace Culture: Teaching and Modeling Behavior

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Abstract

As part of a well-established Industrial Chemical Technology program at Ferris State University, two particular courses have sought to introduce students to the requirements and expectations of the workforce. The first is an eight-hour lab course in Chemical Manufacturing and Analysis. The second is a course in Safety in the Chemical Lab. These courses will be discussed both in the context of preparing students for the culture of an industrial chemistry facility and in the context of feedback and assessment from employers.

Industrial Chemistry at Ferris State University

Associate in Applied Science (AAS) in Industrial Chemistry Technology
- Established in 1957
- Emphasis – Preparing students to work in a Chemistry Lab
- Approximately 475 graduates
- Traditional Coursework in Chemistry and Physics – 35 hours
  - General (2 semesters), Organic (2 semesters), Quantitative Analysis, Instrumental Analysis, Introductory Physics (2 semesters)
- Additional Coursework in Industrial Chemistry – 10 hours
  - Orientation to Industrial Chem, Safety, Industrial Chemical Calculations, Chemical Manufacturing Analysis
- Program Outcomes: Upon completion of the program, students should
  1. demonstrate a working knowledge of chemistry through problem solving, application, and critical evaluation of resources.
  2. work in a chemistry laboratory in a safe and effective manner, applying the scientific method to the design, execution and interpretation of experiments and experimental data.
  3. effectively communicate and present technical information in a clear, concise, scientifically appropriate manner in a variety of formats.

Bachelor of Science (BS) in Industrial Chemistry – Fermentation Science Concentration
- Established in 2015
- Emphasis – Preparing students to work in an industrial setting that using microbiology as a tool for chemical production and synthesis
- Traditional Coursework in Chemistry, Physics, and Biology – 54 hours
  - General (2 semesters), Organic (2 semesters), Quantitative Analysis, Instrumental Analysis, Biochemistry, Physical Chemistry, Introductory Physics (2 semesters), General Biology (2 semesters), Microbiology
- Additional Coursework in Industrial Chemistry – 21 hours
  - Orientation to Industrial Chemistry, Safety, Industrial Chemical Calculations, Chemical Manufacturing Analysis, Fermentation Chemistry (2 semesters), Internship
- Program Outcomes: Upon completion of the program, students should
  1. demonstrate a working knowledge of chemistry through problem solving, application, and critical evaluation of resources.
  2. describe and explain the role of microorganisms in the production of industrially fermented products.
  3. select and apply appropriate chemical and biological methods for identifying sources and causes of contamination in the fermentation process.
  4. effectively discuss and report technical information in a clear, concise, scientifically appropriate manner in a variety of formats.
  5. establish a safe and healthy lab environment for the production of consumable food and beverage while applying the scientific method to the design, execution and interpretation of experiments and experimental data.
  6. develop, manage, and broaden their network of professional contacts within the commercial chemical and fermentation communities.

Bachelor of Science (BS) in Industrial Chemistry – Manufacturing Concentration
- Established in 2015
- Emphasis – Preparing students to work in an industrial setting for chemical production and synthesis
- Traditional Coursework in Chemistry and Physics – 45 hours
  - General (2 semesters), Organic (2 semesters), Quantitative Analysis, Instrumental Analysis, Biochemistry, Inorganic Chemistry, Physical Chemistry, Introductory Physics (2 semesters)
- Additional Coursework in Industrial Chemistry – 17 hours
  - Orientation to Industrial Chemistry, Safety, Industrial Chemical Calculations, Chemical Manufacturing Analysis (2 semesters), Internship
- Program Outcomes: Upon completion of the program, students should
  1. demonstrate a working knowledge of chemistry through problem solving, application, and critical evaluation of resources.
  2. operate in a safe, productive, and effective manner in chemistry and related labs, adapt to a variety of settings, and generate data using synthetic, wet, and instrumental techniques.
  3. effectively report their own experimental results, present information from the literature, and be clear to their audience while using written, verbal, and electronic formats.
  4. ask informed questions and critically evaluate existing information in the chemical literature.
  5. develop, manage, and broaden their network of professional contacts within the commercial chemical communities.

CHEM 145 Safety – The Chemical Lab

Course Description:
Introduction to the chemical lab and the safety related responsibilities of the practicing chemist and/or technologist. Emphasis is placed on the safe handling and storage of hazardous materials, recognizing non-compatible materials, understanding and interpreting safety documents such as MSDS sheets, and in general becoming a safety conscious lab worker. Pre-Requisites: CHEM 121.

Course Outcomes: Upon completion of this course, a student will
1. continue the development of the attitude and background a successful technologist displays.
2. become keenly aware of the chemical laboratory from a safety standpoint, through not only recognition, but also appropriate calculations.
3. be able to make sound judgments from a safety standpoint on what types of materials are compatible.
4. be able to safely work with hazardous material, limit one's overall exposure to them, and correctly dispose of such materials.
5. realize and begin to think about the large safety and health problems facing laboratories and the world.

Course Structure and Format:

This introductory level course is typically taken during the second semester of the student's curriculum, concurrent with the second semester of General Chemistry. It is a two credit hour course meeting twice each week in a small lecture/discussion format with a typical enrollment of 10-20 students.

Students complete weekly homework assignments and maintain a safety file summarizing current articles on safety related issues and incidents. These lead to unit exams and a final exam at the end of the semester.

Basic Premise:

Students are motivated by requirements that they must successfully complete. A required course in Safety signals to the students that it is vital, especially at the beginning of their studies. It cannot be ignored and lack of attention cannot be "made up for" by doing really well on other more interesting topics. Students must pass the course with a grade of C or better in order to continue to higher level coursework and instructors of those courses can expect and require a higher level of attention to detail in safety-related issues because of the required student background.

CHEM 245 Chemical Manufacturing Analysis

Course Description: A laboratory intensive course stressing the preparation and analysis of various materials including plastics, pesticides, and petroleum products, as well as a variety of pure substances. Characterization by instrumental methods, testing by use of American Society tests and materials methods, and notebook keeping are also emphasized. Lecture topics include polymer synthesis and characterization as well as special topics in analysis. Pre-Requisites: CHEM 321 and CHEM 231.

Course Outcomes: Upon completion of this course, a student will
1. reap the rewards of an independent thinker and worker, as well as learning to cooperate with and be part of a team.
2. gain a broader understanding of basic analytical and synthetic chemistry while working with real world samples.
3. become safely familiar with a variety of new reagents and new analytical techniques and to integrate this knowledge with basic wet chemical and instrumental skills to solve laboratory problems.
4. interpret as well as follow directions and produce reliable data, using methods standard to a wide variety of industries as well as less defined synthetic procedures.
5. maintain a high quality laboratory notebook in content and form.
6. complete projects in a timely fashion with presentable results.
7. gain experience with delivering a talk in front of a group.
8. work safely in the lab at all times.

Course Structure and Format:

This course is typically taken during the second or third year of the student's curriculum, often concurrent with Instrumental Analysis. It is a four credit hour course with a typical enrollment of 8-10 students. One lecture hour per week is a "mandatory lab meeting" where the experiment and issues related to management and safety are discussed. In addition, the students are expected to put in an eight-hour day to finish the assigned tasks and are allowed a high degree of flexibility to accomplish this anytime between 8:00 am and 6:00 pm on Monday each week.

Students complete weekly lab reports and maintain a lab notebook, these making up the majority of the grade. They also complete both a midterm and a final exam and report on select results to the class at the end of the semester in a formal presentation.

Basic Premise:

This course simulates a typical work day in a chemical lab. The lab experiment and project changes each week to cover a variety of experiences. Timing is flexible and students are forced to learn time-management skills to make sure they accomplish everything necessary while still meeting their other conflicting responsibilities including other courses that might meet at the same time.

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