UNIT REPORT Chemistry MS Assessment Plan Summary

# **Chemistry MS**

### Deliver A Curriculum With Appropriate Discipline Specific Knowledge

#### **Goal Description:**

The program will address the discipline specific knowledge dictated by professional societies and/or professionals in the workforce.

RELATED ITEMS/ELEMENTS------

#### **RELATED ITEM LEVEL 1**

#### Demonstrate Advanced Chemical Thermodynamics Knowledge and Skills

#### Learning Objective Description:

CHEM 5381 (Advanced Physical Chemistry: Thermodynamics). Each student will demonstrate molecular, computational, and statistical viewpoints and explanations of thermodynamic phenomena in chemistry.

#### **RELATED ITEM LEVEL 2**

# Mastery Of Advanced Thermodynamics Knowledge

#### **Indicator Description:**

All graduate students will demonstrate a mastery of the course material through long problem sets, computational chemistry assignments, Excel modeling assignments, and in-class examinations.

#### **Criterion Description:**

100% Pass the Comprehensive Final Exam with at least a 60% score.

#### **Findings Description:**

Of the 19 graduate students taking the course, 18 successfully met the criterion. One student fell short with a 59% score on the exam. This particular student had a protracted period of absences due to surgery in the middle of the semester. Their performance was compensated by extra effort on the homework assignments, leading to their successful completion of the course.

**RELATED ITEM LEVEL 3** 

Development of Tutorial Material

Action Description:

Prepare material for remedial and tutorial use for those students who are struggling with the material or who fall behind.

#### **RELATED ITEM LEVEL 1**

#### Demonstrate Knowledge of Advanced Topics in Polymer Chemistry Learning Objective Description:

Polymer chemistry is a multidisciplinary subfield of chemistry. This graduate level course is organic-chemistry-based although it includes aspects of analytical, biological, inorganic, materials and physical chemistry. The first 60% of the course involved polymer synthesis and the next 30% covered polymer characterization, both presented in lecture format. The final 10% of the class was reserved for student presentations on an advanced topic related to polymer chemistry.

#### **RELATED ITEM LEVEL 2**

#### Examination of Student Understanding of Advanced Topics in Polymer Chemistry

#### **Indicator Description:**

All students in the class are evaluated by written examination. In the past, the third exam in the course was based primarily on the key points from the student presentations on advanced topics. Due to the lower enrollment in the spring 2016 the third exam also contained material from the instructor's lecture and was more comprehensive then the previous time the course was offered.

#### **Criterion Description:**

All students will score above one standard deviation below the mean on the third exam.

#### **Findings Description:**

During the Spring 2016 semester, 7 out of 8 students scored higher than one standard deviation below the mean.

#### **RELATED ITEM LEVEL 3**

# Add Peer Evaluations and Presentation Summaries Action Description:

The action remains the same the next time this course is offered; students will be required to evaluate and summarize the key points of their peers' advanced topic presentations. These evaluations and summaries will be posted anonymously for the whole class to view. In this way, the students will be more engaged in the presentations and the key points will be more apparent to all students.

#### **RELATED ITEM LEVEL 1**

Demonstrate Knowledge of the Electronic Structure of Metal Complexes

#### Learning Objective Description:

CHEM 5374 "Chemistry of Coordination Compounds" is a course about transition metal complexes. An understanding of the nature of the metal-ligand bond is essential for students to address the rest of the material in the course.

#### **RELATED ITEM LEVEL 2**

# Mastery of the MO Diagram for Octahedral Metal Complexes

#### **Indicator Description:**

Graduate students in this course will demonstrate their mastery of the sigma only molecular orbital energy diagram for an octahedral metal complex by constructing such a diagram on an examination given the group theory character tables and the appropriate symmetries of the ligand orbitals.

#### **Criterion Description:**

Over 90% of the students will score over 3 on a 5 point scale on the question "Draw a full molecular orbital energy diagram for  $M(NH_3)_6^{n+}$  where  $M^{n+}$  is a transition metal. The symmetries of the lone pairs of ammonia are  $a_{1g}$ ,  $e_g$  and  $t_{1u}$ ."

#### **Findings Description:**

Eight students scored 5 on this question. One scored 4.5. Four scored 4. Two scored 3 and 1 scored 1. Thus 10/13 = 77% scored above a 3 and 12/13 = 92% scored a 3 or above. Thus the criterion was not met.

#### **RELATED ITEM LEVEL 3**

#### **Monitor Student Preparation and Progress**

#### **Action Description:**

With the most recent offering of CHEM 5374, the criterion was not met. It turns out that the MO background of the three students who scored 3 or under was relatively weak. In the next offering of the course, an attempt will be made to assess students' background in this area and to provide supplemental materials to those whose background is weak.

#### **RELATED ITEM LEVEL 1**

#### Demonstrate Understanding Drug Development and Drug Antagonism

#### **Learning Objective Description:**

CHEM 5373 "Drug and Toxin Biochemistry" discusses biologically active molecules (mechanism of their action in the body, receptor theory, biotransformation, pharmacokinetics and antagonism) through the extrapolation of the state of the art in drug antidotal therapy that employs the addition of exogenous metabolizing enzymes to destroy toxic molecules in the body. As examples for the worst toxic molecules, the course also discusses chemical warfare agents (historical application, mode of action, and antidotal approaches). The phases of drug development process are also covered following the approach of "Molecules from the Research Labs to the Hands of Doctors to Treat Diseases and Chemical Intoxications".

#### **RELATED ITEM LEVEL 2**

# Examination of Student's Understanding of Elements of Industrial Biochemistry

#### **Indicator Description:**

All students in the class are evaluated by a final written comprehensive examination.

#### **Criterion Description:**

80% of the students taking the final exam will score within one standard deviation of the mean or higher on the comprehensive final exam.

#### **Findings Description:**

During the spring 2016 semester, 25 students (MS and PhD) from different departments took the course: (17 MS Chemistry; 3 MS Forensic; 4 PhD Forensic; 1 MS Agri. Sci & Eng. Tech.). The teaching material was adjusted to the requirements of the diversity of the class, with more emphasis on chemical and biological warfare agents. Originally this topic was planned for a course for the Forensic Science PhD program. Out of the 25 students 23 (92%) met the above criterion. The two students who did not meet the criterion were from Chemistry MS program.

#### **RELATED ITEM LEVEL 3**

## Recommendations for the next Drug and Toxin Biochemistry course

#### Action Description:

The next time the course is offered, students' progress will be monitored by offering more than just the final exam, and their oral presentations and their participation in the presentations (asking questions, sharing their critiques) will be included in the final grade.

In the syllabus the grading criteria will be clearly described.

## **Develop Presentation Skills**

**Goal Description:** 

The ability to communicate research and knowledge are fundamental presentation skills in chemistry.

RELATED ITEMS/ELEMENTS -----

**RELATED ITEM LEVEL 1** 

**Demonstrate Presentation Skills** 

Learning Objective Description:

Students completing CHEM 5100 will, at least once during their tenure as graduate students, demonstrate the ability to make a research presentation.

**RELATED ITEM LEVEL 2** 

#### **Acceptable Student Seminar Peer-Reviewed Presentation**

#### **Indicator Description:**

During their tenure as graduate students, all students will present at least one departmental seminar. The faculty, through the peer-review evaluation rubric, will determine the presentation's acceptability.

#### **Criterion Description:**

All graduate students in chemistry are required to take CHEM 5100 at least once during their tenure as graduate students. To pass CHEM 5100, students are required to receive an acceptable peer-rating on a required research presentation. Within the course, each student evaluates all other student presentations. The rubric is the last page of the syllabus.

#### Attached Files

#### **5100 syllabus haines S2016**

#### **Findings Description:**

The addition of a required 5 minute time period for student's to write comments at the end of each presentation was established, but after four presentations it was clear that it was having the undesirable side effect that students were left bored after writing comments, which did improve slightly in level of detail as observed by the professor. After those presentations, the professor decided that the benefit was outweighed by the negative effects on student in-class dynamics and the method was discarded (after the professor made the class promise to keep writing more detailed comments or it would return). In the spring semester, some professor-moderated in-class discussion of specific aspects of presentations occurred after each presentation (the professor asked questions of the class about presentation form and slide design decisions), and this was found to be very beneficial to productive feedback. All (100% of 17 in Fall 2015, 100% of 6 in Spring 2016) presentations were deemed suitable by the student peer evaluators (as determined by a median score of at least 21 out of 30 points) and by the course professor (assigned score of at least 70 out of 100). Once again, the student comments were found to be almost entirely positive and helpful, but at times still overly brief. There was a small observed improvement, however.

#### **RELATED ITEM LEVEL 3**

#### **Graded seminar critiques**

#### **Action Description:**

The professor will continue and increase the post-presentation discussion, and will try a new method in which a fraction of the course grade is assigned to their written critiques. This will require the critique-writing students' names to be added to the feedback form, but the professor can cut the tops of the forms off before giving them to the presenting students.

## Update to Previous Cycle's Plan for Continuous Improvement

#### Previous Cycle's Plan For Continuous Improvement (Do Not Modify):

As pointed out previously, the master's program is different that our undergraduate programs in a variety of ways. Most importantly for assessment purposes, with the exception of our seminar class (CHEM 5100), graduate research (CHEM 6398) and thesis (CHEM 6099), our courses are not offered every year. They aren't necessarily offered every other year--the frequency varies based on the instructors' other demands and the needs of the students in the program.

For the seminar, the instructor plans on providing a set time period at the end of the presentation to give the students enough time to provide thoughtful critiques.

For CHEM 5372 "Advanced Biochemistry I", the next time the course is offered, the instructor will provide additional material about spectroscopic methods used in enzymatic studies, and the criterion will be raised.

For Nanoscience and Nanosensing, the next time the course is offered, there will be more student exercises exploring problems with calibration and validation, as well as more supporting problems from the primary literature.

The next time analytical spectroscopy is offered the criterion may be raised even further.

The next time organic reaction mechanisms is offered the instructor intends to increase the number of small problem sets required of the students. Update of Progress to the Previous Cycle's PCI:

As pointed out previously, the master's program is different that our undergraduate programs in a variety of ways. Most importantly for assessment purposes, with the exception of our seminar class (CHEM 5100), graduate research (CHEM 6398) and thesis (CHEM 6099), our courses are not offered every year. They aren't necessarily offered every other year--the frequency varies based on the instructors' other demands and the needs of the students in the program.

As a consequence of this, the graduate courses mentioned in the previous cycle were not offered this year, so there is nothing to update.

## **Plan for Continuous Improvement**

**Closing Summary:** 

As pointed out previously, the master's program is different that our undergraduate programs in a variety of ways. Most importantly for assessment purposes, with the exception of our seminar class (CHEM 5100), graduate research (CHEM 6398) and thesis (CHEM 6099), our courses are not offered every year. They aren't necessarily offered every other year--the frequency varies based on the instructors' other demands and the needs of the students in the program.

For the seminar, providing a set time period at the end of the presentation to give the students enough time to provide thoughtful critiques proved to be a problem. The instructor added post-presentation discussion and plans to expand it. He will also make critique-writing a portion of the students' grade.

For CHEM 5381 "Advanced Physical Chemistry: Thermodynamics", the next time the course is offered, the instructor will provide additional tutorial material for students who are struggling with the material or who fall behind. about spectroscopic methods used in enzymatic studies, and the criterion will be raised.

For CHEM 5374 "Chemistry of Coordination Compounds", in the next offering of the course an attempt will be made to assess students' background in this area and will provide supplemental materials for those with weak backgrounds.

For CHEM 5373 "Drug and Toxin Biochemistry" additional graded exercises will be offered.

The next time polymer chemistry is offered the students will be required to evaluate and summarize the key points of their peers' presentations.