

## ANNUAL PROGRAM REPORT

College	College of Science
Department	Chemistry and Biochemistry
Program	BS/BA Chemistry, BS/BA Biochemistry, and MS Chemistry
Reporting for Academic Year	2022-2023
Department Chair	Patrick E. Fleming
Author of Review	Marlin Halim
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### I. SUMMARY OF ASSESSMENT

#### A. Program Learning Outcomes

##### **Program Learning Outcomes (PLO) for BS/BA Chemistry and BS/BA Biochemistry:**

1. Demonstrate knowledge in the various areas of chemistry, including inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, and biochemistry (ILO 6).
2. Use quantitative reasoning to analyze and solve chemical/biochemical problems and evaluate chemical/biochemical data (ILO 1 & 6).
3. Work effectively and safely in a laboratory environment to perform experimental procedures and operate modern chemical/biochemical instruments (ILO 6).
4. Design, carry out, record and analyze the results of chemical/biochemical experiments (ILO 6).
5. Communicate chemical and biochemical issues clearly (ILO 2 & 6).

##### **Program Learning Outcomes (PLO) for MS Chemistry:**

1. Demonstrate mastery of specialized knowledge in the chemical sciences beyond the undergraduate level (ILO 6).
2. Work effectively and safely in a laboratory environment using chemistry laboratory techniques and chemical/biochemical instrumentation (ILO 6).
3. Use theoretical and experimental chemistry methods to test hypotheses or analyze and design solutions to problems (ILO 1 & 6).
4. Research, understand, organize, and critically assess information from the chemical literature (ILO 6).
5. Present complex chemical information via oral and written reports (ILO 2 & 6)

#### B. Program Learning Outcomes Assessed

**BS/BA Programs:** Based on our long-term curriculum assessment plan, the assessment focus of the academic year 2022-2023 is PLO 5. The data was collected from 3 classes: i) Chem 443 (Biochemistry Laboratory I) in Fall 2022 for the BA/BS Biochemistry programs, ii) Chem 420 (Instrumental Analysis) in Fall 2022 for the BS Chemistry programs, and Chem 320 (Bioanalytical and Forensic Instrumentation) in Spring 2023 for the BA Chemistry candidates.

*Instrument:* Submitted work (laboratory reports) by students.

*Sampling Procedure:* All submitted work.

*Sampling Characteristics:* Written products (lab reports).

*Data Collection:* The data was collected in Fall 2022 and Spring 2023.

*Data Analysis:* The submitted work was assessed for learning mastery by the instructor-in-charge using the university ILO Written Communication Rubric (ILO 2).

**MS Program:** PLO 1 was assessed in the academic year 2022–2023. The data was collected from Chem 631 (Graduate Organic Chemistry) in Spring 2023.

*Instrument:* Embedded final exam questions that map to the course SLOs.

*Sampling Procedure:* All submitted final exams.

*Sampling Characteristics:* Written products (final exam).

*Data Collection:* The data was collected in Spring 2023.

*Data Analysis:* The submitted work was assessed for learning mastery by the instructor-in-charge.

### C. Summary of Assessment Results

#### Main Findings

**For both courses (Chem 443 and Chem420), the submitted work was evaluated by the course instructors using the university ILO Written Communication Rubric that has 4 components and each component is scored from 1 – 4 (4 is the highest).**

- i. **Chem 443 (Biochemistry Laboratory I):** learning mastery was assessed based on the submitted written laboratory reports that reflected their mastery of scientific communication. A total of 12 lab reports submitted by Biochemistry BS and BA candidates were assessed. The table below shows the number of submitted work that obtain a score of 3 or higher in each criterion on the ILO Written Communication Rubric.

<b>Criteria</b>	<b># of students that scored 3 or 4</b>	<b># of students that scored 4</b>	<b>% of students with score 3 and above</b>
Purpose, thesis or controlling idea(s)	11 out of 12	8 out of 12	92%
Organization, cohesion, and clarity	10 out of 12	5 out of 12	83%
Presentation of supporting ideas	10 out of 12	3 out of 12	83%
Language and Mechanics	12 out of 12	3 out of 12	100%

- ii. **Chem 420 (Instrumental Analysis):** learning mastery was assessed based on the submitted written laboratory reports that reflected their mastery of scientific communication. A total of 8 lab

reports submitted by Chemistry BS candidates were assessed. The table below shows the number of submitted work that obtain a score of 3 or higher in each criterion on the ILO Written Communication Rubric.

Criteria	# of students that scored 3 or 4	# of students that scored 4	% of students with score 3 and above
Purpose, thesis or controlling idea(s)	6 out of 8	3 out of 8	75%
Organization, cohesion, and clarity	7 out of 8	3 out of 8	88%
Presentation of supporting ideas	5 out of 8	3 out of 8	63%
Language and Mechanics	7 out of 8	3 out of 8	88%

- iii. **Chem 320 (Bioanalytical and Forensic Instrumentation):** learning mastery was assessed based on the submitted written laboratory reports that reflected their mastery of scientific communication. A total of 2 lab reports submitted by Chemistry BA candidates were assessed. The table below shows the number of submitted work that obtain a score of 3 or higher in each criterion on the ILO Written Communication Rubric.

Criteria	# of students that scored 3 or 4	# of students that scored 4	% of students with score 3 and above
Purpose, thesis or controlling idea(s)	2 out of 2	2 out of 2	100%
Organization, cohesion, and clarity	2 out of 2	2 out of 2	100%
Presentation of supporting ideas	2 out of 2	1 out of 2	100%
Language and Mechanics	2 out of 2	2 out of 2	100%

**Analysis of BA/BS programs:** Of the total submitted work from 22 students (all of BS/BS Chemistry and Biochemistry candidates):

- 17 (77%) or more students scored 3 or higher in all four criteria of the rubric.
- 19 (86%) of more students scored 3 or higher in three of the four criteria of the rubric.

Therefore, we believe that the written communication learning objectives have been met.

- iv. **Chem 631 (Bioanalytical and Forensic Instrumentation):** learning mastery was assessed on whether the embedded questions were answered correctly or not.

The course SLOs are as follows. Students who successfully complete Chem 631 should be able to:

1. predict the geometric structure, reactivity and other properties of organic molecules
2. predict the conformational preference of organic molecules and the stereochemical preference in reactions

3. describe different types of reactive intermediates and their importance in reactions
4. evaluate and apply different techniques for the determination of mechanisms of organic reactions
5. predict products or design syntheses of carbon-carbon bond formation reactions
6. determine structure of organic molecules through use of IR, NMR, and mass spectrometry.

The embedded exam questions map to SLOs 2, 3, 4, 5, and 6.

**SLO#2.** predict conformational preference of organic molecules and the stereochemical preference in reactions

Meets expectation on question #11 if answered correctly

Question #11	
Meets expectation	Does not meet expectation
7/14 students	7/14 students

**SLO#4.** evaluate and apply different techniques for the determination of mechanisms of organic reactions

Meets expectation on question #14 if 6 out of 8 parts or more answered correctly

Question #14	
Meets expectation	Does not meet expectation
12/14 students	2/14 students

**SLO#5.** predict products or design syntheses of carbon-carbon bond formation reactions

Meets expectation on question #17 if 1 out of 2 parts or more answered correctly

Question #17	
Meets expectation	Does not meet expectation
10/14 students	4/14 students

**SLO#6.** determine structure of organic molecules through use of IR, NMR, and mass spectrometry

Meets expectation on question #18 if 2 out of 3 parts or more answered correctly

Question #18	
Meets expectation	Does not meet expectation
6/14 students	8/14 students

**Analysis of MS program:** 50% of the students were able to meet the expectation for SLO #2, 86% for SLO#4, 71% for SLO#5, and 43% for SLO#6, The SLOs that students had the most difficulty meeting were predicting the geometric structure, reactivity and other properties of organic molecules and determining structure of organic molecules through use of IR, NMR, and mass spectrometry.

**Reflections, Recommendation for Program Improvements, and Next Step for Closing the Loop:**

Although majority of the students in all BA/BS and MS programs have met the learning outcomes, not all of them have. We plan to address this by providing each student with more feedback and practice in the specific criterion that they need to focus on.

#### **D. Assessment Plan for Next Year**

The BA/BS assessment plan for the academic year 2023–2024 is PLO 1 which aligns with ILO 6 (Specialized Discipline). The data will be collected in Chem 332 (Organic Chemistry II), Chem 352 (Physical Chemistry II), and Chem 442 (Biochemistry II) using embedded questions in assignments and exams. For the MS program, we will be assessing PLO 2.