UNIT REPORT

Chemical & Biological Engineering - APR Self-Study Report by Academic Unit/Department

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Program Mission

Chemical and Biological Engineering Mission

Program Mission Statement:

The mission of the Department of Chemical and Biological Engineering is to provide quality educational programs firmly based in fundamental concepts and to perform and publish outstanding research.

Program Goal (add a minimum of 3 program goal "plan items")

Goal 1: Provide Quality Education

Goal Statement:

Prepare students with a broad-based education grounded in chemical and biological engineering fundamentals.

Alignment to UI Strategic Plan Goals:

Innovate (Goal 1): Scholarly and creative products of the highest quality and scope, resulting in significant positive impact for the region and the world.
Engage (Goal 2): Suggest and influence change that addresses societal needs and global issues, and advances economic development and culture.
Transform (Goal 3): Increase our educational impact.

Indicators/Metrics to Evaluate Progress:

1. Hands-on education is important in both Chemical Engineering and Biological Engineering. One of the indicators of quality education is the collective number of hands-on training hours in all courses. Practical training needs to agree with contemporary industry standards and in lab facilities that closely resemble those in industry. We will evaluate the quality of education by student assessment in upper-division courses.
2. Placement after graduation. Quality education should increase the demand for our students going to both graduate school and industry. We will track the student placement as a metric to evaluate our educational quality.
3. Feedback from students, recent graduates, and alumni reveals the quality of our education. We will use instructor and the course feedback for each course, interview of graduating seniors, feedback from capstone sponsors, and an alumni survey to assess the quality of our education.

List of Actions the Program Will Take to Achieve Goals :

1. Document the number of practical training hours in various course to track progress.
2. Evaluate the age of technologies used in the labs and document the currency of the technology. Based on this assessment, we will improve teaching labs and re-evaluate courses.
3. Engage with employers and alumni to seek feedback on current industrial practices, educational needs, and both short- and long-term anticipated changes in industry.
4. Conduct graduate and alumni feedback surveys to gauge their perception of a quality education.

Goal Achievement Level: In Progress

Goal 2: Cultivate a Positive Environment

Goal Statement:

Maintain an environment that promotes effective student/faculty involvement in teaching, research, and mentoring.

Alignment to UI Strategic Plan Goals:

Engage (Goal 2): Suggest and influence change that addresses societal needs and global issues, and advances economic development and culture.
Transform (Goal 3): Increase our educational impact.
Cultivate (Goal 4): Foster an inclusive, diverse community of students, faculty, and staff and improve cohesion and morale.

Indicators/Metrics to Evaluate Progress:

1. Student Graduation rate. Continuously improving graduation rates from the baseline of 2020 would be an indicator of a positive environment and student success.

2. Student feedback and graduate surveys. Graduating student surveys and feedback from students on the learning environment provides an opportunity to understand the current situation and plan for improvements.

List of Actions the Program Will Take to Achieve Goals :

1. Engage early. Early engagement with students in introductory courses allow students to understand the departmental culture and help improve their sense of belonging.
2. Develop a system for students to easily communicate to the department with their questions, concerns, suggestions, and observations in a positive environment.

Goal Achievement Level: In Progress

Goal 3: Practice Citizenship

Goal Statement:

Graduate students with a sense of social responsibility, ethics, and a commitment to lifelong learning.

Alignment to UI Strategic Plan Goals:

Innovate (Goal 1): Scholarly and creative products of the highest quality and scope, resulting in significant positive impact for the region and the world.
Engage (Goal 2): Suggest and influence change that addresses societal needs and global issues, and advances economic development and culture.
Transform (Goal 3): Increase our educational impact.
Cultivate (Goal 4): Foster an inclusive, diverse community of students, faculty, and staff and improve cohesion and morale.

Indicators/Metrics to Evaluate Progress:

1. Student engagement in research and internships
2. Alumni survey

List of Actions the Program Will Take to Achieve Goals :

1. Integrate self-learning activities into the curriculum
2. Provide travel support for students to make conference presentations
3. Provide opportunities to engage in various student clubs related to contemporary issues

Goal Achievement Level: In Progress

Student Learning Assessment Report (add one "plan item" for each major, degree, and/or certificate offered by dept)

Chemical Engineering B.S.

Assessment Report Contact: Dev Shrestha

Program Changes in Past Year:

Program Change

The B.S. Degree in Materials Engineering is being discontinued, but will be managed through the department until the last students have completed their degrees in May 2023.

The Department of Chemical Engineering recently merged with the Department of Biological Engineering to form the Department of Chemical and Biological Engineering

Curricular Change

CHE 210/Integrated Chemical Engineering Fundamentals: course removed from Chemical Engineering curriculum

ChE/MSE elective 390 or higher was changed to ChE/BE elective of 390 or higher

ChE 445 requirement was replaced with ChE elective of 390 or higher

Learning Outcomes are Communicated to All Students in Program (check box if true):

Learning Outcomes are Communicated to All Faculty (check box if true): true

Optional: Framework Alignment:

Import Outcomes Data (from Anthology Outcomes):

The B.S. degree in Chemical Engineering is an ABET-accredited Engineering Program. The program has five Program Educational Objectives (PEOs) that match with the University learning outcomes. They are:

1. Are well-grounded in the fundamentals of chemical engineering,
2. Can understand, analyze, and design efficient processes,
3. Are proficient in the oral and written communication of their work and ideas,
4. Are able to work in multidisciplinary teams in conjunction with their design, formulation of problems, and conducting of experiments,

5. Understand the safety and environmental consequences of their work, and
6. Are instilled with a sense of social responsibility, ethics, and a commitment to life-long learning.

ABET does not require assessment of PEOs, but does require that they be reviewed by faculty and stakeholders once each year.

ABET has defined seven Student Outcomes (SO) that are assessed for each degree program:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Current mapping of PEO's and ABET Student Outcomes are as below:

ChE Program Education Objectives #	Evaluated by ABET SO #
1	1,2,4 and 6
2	1,2, and 6
3	3
4	1,2,5 and 6
5	2 and 4
6	4 and 7

The courses that evaluate these ABET SO's are shown below

UI ChE Program Educational Objective (PEO) [See Table 3.1]	**ABET SO**	ChE 110	ChE 123	ChE 210	ChE 223	ChE 326	ChE 330	ChE 340/341	ChE 423	ChE 433/434	ChE 444/445	ChE 453/454	ChE 491	ChE elective	Engr 240	Engr320/335
Fundamentals of ChE	1	X	X	X	X	X	X	X	X	X	X	X		X	X	X
(Apply engrg design; safety)	2		X			X	X	X	X	X	X	X	X			
Proficient communication	3	X	X		X		X	X	X	X	X	X			X	X
Safety/environmental consequences (*ethics*)	4 7	X	X		X					X	X	X	X			
Team design, problem formulation, experiments	5 6		X	X						X	X	X				
Understand, analyze, de(velop) efficient processes	6			X		X	X	X	X	X	X	X				
Social responsibility, ethics, life-long learning	7 4	X				X	X			X	X	X		X		

The Chemical Engineering faculty recognize that the formative lower-division courses are not as applicable to overall program assessment toward our student objectives and outcomes by their design and purpose. These data (below) from upper division courses indicate that all student outcomes (SOs 1-7) have been met on the course review basis.

ABET Student Outcomes	ChE 326	ChE 330	ChE 340	ChE 341	ChE 423	ChE 433	ChE 434	ChE 444	ChE 445	ChE 453	ChE 454
SO 1 (a, e, k)	Met Met	Met Met	Met Met	Met Met	Met Met			Met Met	Met *N/A*	Met *NOT*	Met Met
SO 2 (c, k)	Met Met	Met Met	Met Met	Met Met	Met Met			*NOT*	*NOT*	Met Met	Met Met
SO 3 (g)			Met Met	Met Met		Met Met	Met Met			Met *N/A*	Met Met
SO 4 (f, h, j)										*N/A* *NOT*	Met Met
SO 5 (d)							Met *N/A*	*N/A* Met	*N/A* Met	Met *N/A*	Met Met
SO 6 (b, k)	*NOT* Met	*NOT* Met	Met Met	Met Met	Met *N/A*	Met Met	*N/A* Met	Met Met	Met Met	Met Met	Met Met
SO 7 (i)								*N/A* Met	*N/A* *NOT*		Met Met

In addition to internal assessment by course instructor, external evaluator scores were assigned for SO 1-6 in ChE 453/454 and for the project report for SO 7. The result indicates that *every student outcome (**SO 1-7**) has been met*

ABET SO	1	2	3	4	5	6	7
Mean	3.8	3.9	4.3	3.8	4.4	3.8	3.5
StDev	0.4	0.1	0.3	0.4	0.3	0.4	0.8

The Score is interpreted as: 5 = exceptional, 4 = exceeds requirement, 3 = meets requirement 2 = below requirement, 1 = weak.

The data after last ABET assessment (2019-2021) shows the following score for ABET student outcomes:

ABET SO	1	2	3	4	5	6	7
Mean	3.9	4.0	4.2	4.2	4.2	4.0	4.1
StDev	0.5	0.5	0.2	0.3	0.2	0.4	0.3

Summary of Student Learning:

The B.S. in Chemical Engineering has well defined-Student Outcomes that are assessed in multiple courses for ABET accreditation. Shortcomings in any category are monitored and corrective actions are taken. The PEO's are reviewed annually by faculty.

The data shows that the program is achieving its Student Outcomes.

Summary of Faculty Discussion:

The Chemical and Biological Engineering faculty periodially review and discuss the Student Outcomes for this program, both offline and during faculty meetings. The faculty approve the way the Student Outcomes are being evaluated.

Summary of Changes/Improvements Being Considered:

Faculty will discuss how to assess inter-rater reliability for Chemical Engineering B.S. in future meetings.

Inter-rater Reliability:

The program currently does not have inter-rater reliability assessment program.

Closing the Loop:

Assessment is never complete, it is an ongoing process. Attached is our last ABET self-study, completed in 2019. The next ABET review will occur in 2025.

Attached Files

Che Self-Study.pdf

Biological Engineering B.S.

Assessment Report Contact: Dev Shrestha

Program Changes in Past Year:

Program Change

The Department of Chemical Engineering recently merged with The Department of Biological Engineering to form the Department of Chemical and Biological Engineering

Curricular Change

ENGR 105 or GEOG 385 requirement removed from BE curriculum

BE 361 was added as a required course

Learning Outcomes are Communicated to All Students in Program (check box if true): true

Learning Outcomes are Communicated to All Faculty (check box if true): true

Optional: Framework Alignment:

Import Outcomes Data (from Anthology Outcomes):

The B.S. degree in Biological Engineering is an ABET-accredited Engineering Program. The program has five Program Educational Objectives (PEOs) that match with the University learning outcomes. They are:

1. **Learn and integrate**: Graduates will be proficient engineering problem solvers capable of identifying, formulating, and solving engineering problems by applying their knowledge of mathematics, engineering, and appropriate biological, chemical, natural resources and/or agricultural topics.
2. **Think and create**: Graduates will be effective engineers who can apply their skills to design systems, components and processes to solve engineering problems for an ever-changing world.
3. **Communicate**: Graduates will be effective written and verbal communicators, and productive team members.
4. **Clarify purpose and perspective**: Graduates will have a strong professional identity with a keen awareness of their professional and ethical responsibility, and practice lifelong learning.
5. **Practice citizenship**: Graduates will design for advancement and sustainability of their local, national and global communities protecting human health and safety, and practicing environmental stewardship.

ABET does not require assessment of PEOs, but does require that they be reviewed by faculty and stakeholders once each year.

ABET has defined seven Student Outcomes (SO) that are assessed for each degree program:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Current mapping of PEO's and ABET SO's are as below:

BE Program Education Objectives #	Evaluated by ABET SO #
1	1
2	6
3	3, 5
4	4
5	2, 7

The courses that evaluate these ABET SO's are shown below (from BE ABET Self-Study, 2019)

Student Outcomes \ BE Courses	(1) 142	(2) 242	(3) 441	(4) 461	(5) 462	(6) 478/ 479	(7) 491	(8) Exit	(9) Alum
(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.			X	X	X			X	N/A
(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	X	X		X	X	X		X	N/A
(3) an ability to communicate effectively with a range of audiences.	X	X		X		X	X	X	N/A
(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	X					X	X	X	N/A
(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	X	X				X		X	N/A
(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions			X	X	X			X	N/A
(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	X		X				X	X	N/A

The minimum acceptable average scores on evaluated materials from the courses was 3.0/5.0 with the target of class average being 4.0/5.0. A summary of the mean and standard deviation of the scores for each ABET Student Outcome is tabulated below:

ABET SO#	1	2	3	4	5	6	7
Mean	4.1	4.3	4.6	4.3	4.4	4.4	4.5
St.Dev	0.1	0.4	0.3	0.6	0.6	0.3	0.4

The data indicate that the assessment of the student outcomes from last ABET cycle (2015-2019) were mostly on target. Some of the areas that were identified as needing improvements are:

1. Incorporation of more engineering ethics in the curriculum (BE 142)
2. More attention to special needs students when they work in a team environment (BE 478)
3. Added hands-on lab modules (BE 461)

Summary of Student Learning:

The B.S. degree program Biological Engineering has well-defined Student Outcomes that are assessed in multiple courses for ABET accreditation. Deficiencies in any outcome is monitored and corrective actions are taken. The Program Educational Objectives (PEOs) are reviewed annually by the faculty.

Summary of Faculty Discussion:

The Chemical and Biological Engineering faculty periodially review and discuss the Student Outcomes for this program, both offline and during faculty meetings. The faculty approve the way the Student Outcomes are being evaluated.

Summary of Changes/Improvements Being Considered:

None

Inter-rater Reliability:

All faculty use the same rubrics and regular discussions are held.

Closing the Loop:

Assessment is never complete, it is an ongoing process. Attached is our last ABET self-study, completed in 2019. The next ABET review will occur in 2025.

Attached Files

BE Self Study.pdf

Biological Engineering M.S.

Assessment Report Contact: Dev Shrestha

Program Changes in Past Year:

No change to the program other than the departmental merger of Chemical and Biological Engineering.

Learning Outcomes are Communicated to All Students in Program (check box if true): true

Learning Outcomes are Communicated to All Faculty (check box if true): true

Optional: Framework Alignment:

Import Outcomes Data (from Anthology Outcomes):

The graduate requirements for Biological Engineering are described in the graduate program handbook. The graduate program assumes that the students are already well-grounded in the fundamentals of Biological Engineering from their undergraduate education. The learning outcome for M.S. program in Biological Engineering are:

1. **Knowledge Base**: An in-depth knowledge of the degree subject matter, integrating and building upon the foundation provided by a relevant undergraduate degree.
2. **Original Research / Design**: An ability to conduct original research and to appropriately and accurately analyze experimental data with insightful discussion.
3. **Communication Skills**: An ability to communicate findings in an appropriate format for disciplinary, interdisciplinary, and lay audiences, both orally and in writing.
4. **Global Citizenship**: An understanding impact of this project or research specifically, and of the responsibility to enhance the quality of life of the global community through the practice of engineering.

In order to meet the learning objectives, the students are required to meet the following requirements:

All M.S. students are expected to carry out a research program as part of their education. No qualifying examination is required for M.S. students.

Major Professor and Committee

During the first semester, the student will work with his/her major professor to select a program of study committee. Normally, the major professor will be the person in charge of the research in which the student is interested. The major professor is the student's point of contact with the department when questions arise about anything connected with their study or research.

The program of study committee (or the Graduate Committee) consists of faculty members that can help the student prepare a plan for coursework and research. For the M.S. degree, the committee will normally consist of three persons including the major professor, but may have up to five. In addition to the major professor, the committee should include one other faculty member from the department and one from outside the department. For the purpose of this requirement, BE affiliate faculty members are considered in the department.

Study Plan

Preferably in the first semester but no later in the end of the second semester, the student has to develop a study plan consisting of coursework to be approved by the student's graduate committee. This study plan may include courses the committee or departmental graduate faculty regards as deficiencies. Examples are courses which are required for an undergraduate degree at UI but have not previously been taken by the student. The credits of these deficiencies do not count toward the degree requirements. Generally, the study plan includes courses related to the thesis project, and courses that fulfill the student's professional objectives.

The M.S. degree requires a minimum of 30 credits in courses numbered 300 and above of which at least 21 credits must be in courses other than BE 500 Master's Research and Thesis. At least 18 credits must be numbered 500 or above (including BE 500), and at least 6 credits must be 500 level BE courses excluding BE 500. BE courses that are required in the BE undergraduate curriculum cannot be used as part of the 30 credits required for the M.S. degree.

A typical program will consist of at least 9 credits of BE 500 and at least 21 credits of coursework other than BE 500. These totals will not include courses taken to correct deficiencies.

An overall GPA of 3.0 or above is required for graduation.

Twelve credits per semester is the maximum allowed for students on an assistantship.

Final Examination

An oral examination (or thesis defense) is required for all M.S. students. The purpose of the final examination is to determine if the student can demonstrate mastery of a subject in depth and demonstrate that the research program was properly carried out and sound conclusions were drawn from the results.

During the semester in which the requirements for the degree (both coursework and research) are expected to be completed, an oral examination will be requested by the student according to the guidelines of College of Graduate Studies and conducted by the student's graduate committee. In this examination, normally two to three hours in length, the student will be required to defend his/her thesis as well as answer questions on related coursework.

The format for the final examination includes that the student prepares a brief presentation (20-30 minutes in length) summarizing his/her research project. This presentation is open to the public and the student is expected to take questions from the audience during or at the end of the presentation. After the presentation, the public will be asked to leave so that the committee continues to question the student privately.

The committee may 1) pass the student with or without special conditions being attached, 2) require a re-examination at a later date, or 3) deny the degree. Appeal of a denial will follow current University of Idaho policies. Consult the College of Graduate Studies (www.uidaho.edu/cogs/) and/or the Dean of Students (uidaho.edu/student-affairs/dean-of-students) for academic appealing procedures in details.

Student Outcome Evaluation

The compiled scores for recent graduate showed the following statistics.

Program Learning Outcome	Average Score*	St.Dev
Knowledge Base:	3.5	0.5
Original Research / Design:	3.8	0.5
Communication Skills:	3.5	0.5
Global Citizenship:	3.5	0.5

* Score is described below

The students are scored from 1 to 4 points the interpretation of score is shown in the table below

BE Student Learning Outcome	Assessment Rubric			
	Exceeds requirements Score:4	**Meets Requirements Score:3**	**Partially Meets requirements Score:2**	**Does Not Meet requirements Score:1**
1. Knowledge Base An in-depth knowledge of the degree subject matter, integrating and building upon the foundation provided by a relevant undergraduate degree.	Demonstrated a thorough knowledge of both breadth and depth of knowledge in discipline. Showed high level of competence in research area.	Demonstrated both breadth and depth of knowledge in discipline. Was competent in research area.	Demonstrated adequate depth in research area, but lacked breadth in discipline.	Did not demonstrate depth in research area.
2. Original Research / Design An ability to conduct original research and to appropriately and accurately analyze experimental data with insightful discussion.	Demonstrated extensive knowledge of published work in area of research and the ability to build on that knowledge. Showed ability to plan and execute original research and to analyze and correctly interpret the results.	Demonstrated adequate knowledge of published work in area of research and ability to build on that knowledge. Showed ability to execute original research and to analyze and correctly interpret the results.	Literature research was weak. Was able to conduct research and analyze and interpret the results under supervision.	Obviously missed many of the important works in the field. Research techniques and analysis weak.
3. Communication Skills An ability to communicate findings in an appropriate format for disciplinary, interdisciplinary, and lay audiences, both orally and in writing.	Thesis was well written using correct, clear and concise English with consistent format. Oral presentation showed good command of language and subject matter. Responses to questions were direct and provide the desired clarification. Excellent use of graphics.	Thesis was well written. Sentence structure and format generally resulted in “easy reading”. Oral presentation was clear and concise. Responses to questions were generally concise and to the point. Graphics were appropriate.	Parts of the thesis were poorly written and/or format was inconsistent. Oral presentation was sometimes hard to follow and responses to questions did not always clarify the point.	Report was poorly written with and difficult to read. Inconsistent format. Poor oral presentation.
4. Global Citizenship An understanding impact of this project or research specifically, and of the responsibility to enhance the quality of life of the global community through the practice of engineering.	Provided a thoughtful analysis of the potential impact of the research, both intended (positive) and unintended (positive or negative), on society. Knew and understood issues involving ethics, sustainability and public health and safety related to research subject.	Provided a sound analysis of the potential impact of the research on society. Was knowledgeable of issues involving ethics, sustainability and public health and safety related to research subject.	Provided a weak analysis of the potential impact of the research on society or was not able to define ethical, sustainability or public health and safety issues.	Was not able to give a cogent analysis of societal context issues.

The data shows that the students met the requirements in each of the categories. There was no score reported below 3.0 in any category.

Summary of Student Learning:

- The M.S. program in Biological Engineering has well-defined learning objectives that are measured during the final defense.
- The average score for all three learning objectives was right around 'Meet Requirements' with no statistically significant difference.

Summary of Faculty Discussion:

The Chemical and Biological Engineering faculty reviewed and discussed the learning outcomes for this program, both offline and during faculty meetings. The faculty approved the student outcomes and the way they are being evaluated.

Summary of Changes/Improvements Being Considered:

The faculty will discuss how to assess inter-rater reliability for Biological Engineering M.S. in future meetings.

Inter-rater Reliability:

The program currently does not have inter-rater reliability assessment program.

Closing the Loop:
Not applicable for first year APR

Biological Engineering Ph.D.

Assessment Report Contact: Dev Shrestha

Program Changes in Past Year:
No change to the program other than the departmental merger of Chemical and Biological Engineering.

Learning Outcomes are Communicated to All Students in Program (check box if true): false

Learning Outcomes are Communicated to All Faculty (check box if true): true

Optional: Framework Alignment:

Import Outcomes Data (from Anthology Outcomes):
The graduate requirements for Biological Engineering are described in the graduate program handbook. The graduate program assumes that the students are already well-grounded in the fundamentals of Biological Engineering from their undergraduate education. The learning outcome for Ph.D. program in Biological Engineering are:

1. **Knowledge Base**: An in-depth knowledge of the degree subject matter, integrating and building upon the foundation provided by a relevant undergraduate degree.
2. **Original Research / Design**: An ability to conduct original research and to appropriately and accurately analyze experimental data with insightful discussion.
3. **Communication Skills**: An ability to communicate findings in an appropriate format for disciplinary, interdisciplinary, and lay audiences, both orally and in writing.
4. **Global Citizenship**: An understanding impact of this project or research specifically, and of the responsibility to enhance the quality of life of the global community through the practice of engineering.

In order to meet the learning objectives, the students are required to meet the following requirements:

Graduate Committee:

During the student's first year, a graduate committee will be appointed. This committee will normally consist of five persons including the major professor. Two members will be from outside the department. These members will provide guidance in preparing the plan of coursework and in reviewing the research topic and research plan of work. The same form that is used to appoint the committee also serves to notify the College of Graduate Studies of the intention to work towards a Ph.D. degree. This committee will meet to evaluate the student's potential for obtaining the Ph.D. degree. This evaluation includes not only an estimate of the student's ability to complete the coursework but also the student's potential for pursuing independent research. Based on this evaluation, the committee will develop a plan for a qualifying examination and implement that plan preferably before the end of the student's first year but definitely no later than the end of the second year.

Qualifying Exam

The intent of the qualifying examination is to establish whether a student has the background and abilities to successfully complete a Ph.D. degree program. The student's graduate committee, upon recommendation of the student's major professor, decides whether and when a student will be required to take the qualifying examination. Consideration is given to the content and student's performance in his or her undergraduate program of study, previous graduate programs of study, if any, as well as work or other relevant experience. The examination may contain written and oral components and will be prescribed and administered by the student's graduate committee. A grade of pass or fail will be given to the student's qualification examination.

Study Plan

A typical program will include 72 credits with at least 42 credits in courses other than BE 600 Doctoral Research and Dissertation. Among the 42 credits of coursework, at least 15 credits have to be 500-level BE courses. At least 52 credits, including BE 600, must be numbered 500 or above. Courses that are required in the BE undergraduate curriculum cannot be used as part of the 42 credits required for the Ph.D. degree.

Preliminary Examination

All students pursuing a Ph.D. degree at BE will be required to take a preliminary examination. The intent of the examination is to evaluate whether the student has adequate knowledge and preparation, or his/her readiness, to conduct his/her dissertation research.

The preliminary examination takes the form of a written research proposal administered by the student's graduate committee. It is designed to help the student organize and plan a research project and to give the student experience in writing a research proposal for critical review on the topics in the field. The essential constituents of nearly all proposals are outlined as follows:

1. Statement of Problem
2. Justification of the Project
3. Objectives of the Project
4. Discussion of Related Research
5. Theoretical Procedure
6. Facilities, Equipment, and other features of the Project

7. Anticipated Results
8. Personnel
9. Project Time Table
10. Budget

Preparation of the proposal should begin upon selection of a research topic. A substantial portion of the proposal will be valuable in writing the final dissertation. In particular, items (a) through (f) will appear in nearly all dissertations. A format should be chosen consistent with the nature of the project.

The research proposal is to be presented orally to the student's graduate committee. During this presentation, the student can be questioned in any manner deemed appropriate. Upon satisfactory presentation of the research proposal, the student will be admitted to Ph.D. candidacy. The committee may ask that the proposal be revised if it is not satisfactory. The Advancement to Doctoral Candidacy Form is filed by the major professor after the graduate committee passes the candidate.

Final Examination

All Ph.D. candidates are required to take a final examination which is a defense of the dissertation. This will normally be two to three hours in duration. The student prepares the Final Defense form, which is to be given to the major professor at the beginning of the exam. During this examination, the student will present the results of the research project approved during the preliminary examination. The graduate committee is free to question the student in any manner deemed appropriate.

The format for the final examination will be for the student to prepare a presentation (typically 30-40 minutes in length) summarizing their research project. This presentation is open to the public and the student is expected to take questions from the audience during or at the end of the presentation. After the presentation, the public will be asked to leave so that the committee continues to question the student privately.

Particular attention will be paid to interpretation of the results since this is the core of doctoral level research. The graduate committee can ask the student to justify any or all inferences and conclusions drawn from the research as well as application to a wider scope of study than that under question.

The graduate committee may 1) pass the student, 2) require rewriting of the dissertation and a re-examination at a later date, or 3) deny the degree. Re-examination cannot occur earlier than eight weeks after the first examination.

Student Outcome Evaluation

The students are scored from 1 to 4 points by the major professor during the final examination. A summary of the learning objective scores are given below:

Program Learning Outcome	Average Score*	St.Dev
Knowledge Base:	4.0	0.0
Original Research / Design:	4.0	0.0
Communication Skills:	3.5	0.7
Global Citizenship:	4.0	0.0

The students are scored from 1 to 4 points the interpretation of the score is shown in the table below

BE Student Learning Outcome	Assessment Rubric			
	Exceeds requirements Score:4	**Meets Requirements Score:3**	**Partially Meets requirements Score:2**	**Does Not Meet requirements Score:1**
1. Knowledge Base An in-depth knowledge of the degree subject matter, integrating and building upon the foundation provided by a relevant undergraduate degree.	Demonstrated a thorough knowledge of both breadth and depth of knowledge in discipline. Showed high level of competence in research area.	Demonstrated both breadth and depth of knowledge in discipline. Was competent in research area.	Demonstrated adequate depth in research area, but lacked breadth in discipline.	Did not demonstrate depth in research area.

2. Original Research / Design An ability to conduct original research and to appropriately and accurately analyze experimental data with insightful discussion.	Demonstrated extensive knowledge of published work in area of research and the ability to build on that knowledge. Showed ability to plan and execute original research and to analyze and correctly interpret the results.	Demonstrated adequate knowledge of published work in area of research and ability to build on that knowledge. Showed ability to execute original research and to analyze and correctly interpret the results.	Literature research was weak. Was able to conduct research and analyze and interpret the results under supervision.	Obviously missed many of the important works in the field. Research techniques and analysis weak.
3. Communication Skills An ability to communicate findings in an appropriate format for disciplinary, interdisciplinary, and lay audiences, both orally and in writing.	Thesis was well written using correct, clear and concise English with consistent format. Oral presentation showed good command of language and subject matter. Responses to questions were direct and provide the desired clarification. Excellent use of graphics.	Thesis was well written. Sentence structure and format generally resulted in "easy reading". Oral presentation was clear and concise. Responses to questions were generally concise and to the point. Graphics were appropriate.	Parts of the thesis were poorly written and/or format was inconsistent. Oral presentation was sometimes hard to follow and responses to questions did not always clarify the point.	Report was poorly written with and difficult to read. Inconsistent format. Poor oral presentation.
4. Global Citizenship An understanding impact of this project or research specifically, and of the responsibility to enhance the quality of life of the global community through the practice of engineering.	Provided a thoughtful analysis of the potential impact of the research, both intended (positive) and unintended (positive or negative), on society. Knew and understood issues involving ethics, sustainability and public health and safety related to research subject.	Provided a sound analysis of the potential impact of the research on society. Was knowledgeable of issues involving ethics, sustainability and public health and safety related to research subject.	Provided a weak analysis of the potential impact of the research on society or was not able to define ethical, sustainability or public health and safety issues.	Was not able to give a cogent analysis of societal context issues.

The data shows that the students met the requirements in each of the categories. There was no score reported below 3.0 in any category.

Summary of Student Learning:

- The Ph.D. program in Biological Engineering has well-defined learning objectives that are measured in several courses and during the final defense.
- The average score for all three learning objectives was right around 'Meets Requirements' .

Summary of Faculty Discussion:

The Chemical and Biological Engineering faculty reviewed and discussed the learning outcomes for this program, both offline and during faculty meetings. The faculty approved the student outcomes and the way it is being evaluated.

Summary of Changes/Improvements Being Considered:

Evaluate student outcome during prelim exam as well by each attending faculty and use data for both quality assessment and inter-rater reliability.

Inter-rater Reliability:

The program currently does not have inter-rater reliability assessment program.

Closing the Loop:

Not applicable for first year APR

Chemical Engineering M.S.

Assessment Report Contact: Dev Shrestha

Program Changes in Past Year:

No program changes for M.S. in Chemical Engineering other than merging of the Chemical and Biological Engineering Departments.

Learning Outcomes are Communicated to All Students in Program (check box if true): true

Learning Outcomes are Communicated to All Faculty (check box if true): true

Optional: Framework Alignment:

Import Outcomes Data (from Anthology Outcomes):

The graduate requirements for Chemical Engineering are described in the graduate program handbook. The graduate program assumes that the students are already well-grounded in the fundamentals of chemical engineering from their undergraduate education. The Student Learning Outcomes (SLO) of M.S. program are:

SLO1: Learn & Integrate: The student(s) will demonstrate expert engineering and science knowledge in a specialty field or subdiscipline.

SLO2 Think & Create: The student(s) will show capability to advance the frontier of knowledge in designated research area.

SLO3 Communicate: The student(s) will effectively communicate research results in oral and written form.

To meet the student learning outcome the M.E. Students take the required course as well as technical electives in their field of research. The general requirements for the M.S. program are divided for two categories of incoming MS students they are:

Students Having a B.S. ChE or Closely Related Degree

The general requirements for the M.S. program are:

Course	Credits
ChE 500 (Thesis)	10
ChE 501 (Seminar ×2)	2
ChE 515 (Transport Phenomena)	3
ChE 529 (Chemical Engr. Kinetics)	3
ChE 541 (Chemical Engr. Analysis I)	3
ChE 5xx (elective)	3
Supporting or ChE electives	6
Total Credits	**30**

For Idaho Falls students, the seminar (ChE 501) can be replaced by other ChE or other closely-related courses approved by advisor and program coordinator. Students may need to work beyond the minimum 30 credits to complete the required coursework successfully.

A MS thesis student should have a committee with a minimum of three faculty members with the major professor as the chair of such committee. While an out-of-department committee member is not a requirement, no more than one outside member may be included in the thesis committee. This requirement is also applicable to MSE degree programs. The MS (thesis) student must defend her/his thesis before the committee and the public during the last semester of attendance.

Students Having other than B.S. ChE or Closely Related Degree

For students not having B.S. in Chemical Engineering or closely related degree, the following "deficiency" courses, or equivalent through other course work or experience, should be taken before admission to the M.S. degree program:

1. Chem 111-112 (Principles of Chemistry I & II)
2. Physics 211-212 (Engr. Physics I & II)
3. Engr 335 (Fluid Mechanics)
4. ChE 223 (Materials & Energy Balances)
5. Math 310 (Ordinary Differential Equations)
6. Chem 305 (Physical Chemistry) ---or--- Engr 320 (Engr. Thermo & Heat Transfer)
7. ChE 326 (ChE Thermodynamics)
8. ChE 330 (Separation Processes)
9. ChE 340 (Transport & Rate Processes I)
10. ChE 341 (Transport & Rate Processes II)

Student Outcome Evaluation

The learning outcomes are evaluated mainly in oral examinations as thesis defense. The students are scored from 1 to 5 points the interpretation of score is shown in the table below

1 = Poor; 3 = Good/Average, 5 = Excellent

The summary score of current graduates was tallied for each evaluator under each

Student Learning Outcome	Average Score	St.Dev.
Learn & Integrate:	3.5	0.6
Think & Create:	3.1	0.9
Communicate:	3.5	0.5

An ANOVA analysis was ran assuming individual student as a group and individual score as random replications. No significant difference in score was observed for students (n = 3) nor between evaluators. The data indicated that there is no system bias between evaluators.

The data shows that the students met the requirement is each of the categories.

Summary of Student Learning:

- The M.S. program in Chemical Engineering has well-defined learning objectives that are measured in several courses and during the final defense.
- The average score for all three learning objectives was right around 'Meet Requirements' with no statistically significant difference.
- There was no significant variance between evaluators in scoring student learning outcomes.

Summary of Faculty Discussion:

The Chemical and Biological Engineering faculty reviewed and discussed the learning outcomes for this program, both offline and during faculty meetings. The faculty approved the student outcomes and the way it is being evaluated.

Summary of Changes/Improvements Being Considered:

No changes are proposed for this program.

Inter-rater Reliability:

Although the program currently does not have inter-rater reliability assessment program. The scores from individual evaluation tested as random variable indicated that there was no statistically significant bias between evaluators.

Closing the Loop:

Not applicable for first year APR

Chemical Engineering Ph.D.

Assessment Report Contact: Dev Shrestha

Program Changes in Past Year:

No program changes for Ph.D. in Chemical Engineering other than merging of the Chemical and Biological Engineering Departments.

Learning Outcomes are Communicated to All Students in Program (check box if true): true

Learning Outcomes are Communicated to All Faculty (check box if true): true

Optional: Framework Alignment:

Import Outcomes Data (from Anthology Outcomes):

The graduate requirements for Chemical Engineering are described in the graduate program handbook. The graduate program assumes that the students are already well-grounded in the fundamentals of chemical engineering from their undergraduate education. The Student Learning Outcomes (SLO) of Ph.D. program are:

SLO1: Learn & Integrate: The student(s) will demonstrate expert engineering and science knowledge in a specialty field or subdiscipline.

SLO2 Think & Create: The student(s) will show capability to advance the frontier of knowledge in designated research area.

SLO3 Communicate: The student(s) will effectively communicate research results in oral and written form.

To meet the student learning outcome the Ph.D. students take the required course as well as technical electives in their field of research. The general procedures for students pursuing doctoral degrees at the University of Idaho are contained in the University Catalog and COGS website. Each student is responsible to read and understand these general rules/regulations.

Qualifying Examination

The qualifying exam is an evaluation of past performance and of potential for successfully completing a PhD degree, as well as a critique of a recent research publication. The student will be given 4-7 citations and asked to pick one for critique and presentation. A concise written paper will be presented to the faculty as a whole and a 30-minute oral presentation will be given two weeks later. Alternatively, students may present their own original work as a basis for the qualifying examination, for example, a research publication or an MS thesis.

The written presentation should consist of an introduction stressing significance and summarizing related work and discussion, critique, and suggestions for extension of the work. The oral presentation should follow a similar format. The oral presentation will be given on the Moscow campus either in person or via compressed video and will be open, followed by a closed session with the Department faculty. During the closed session the student will be questioned on both the critique and other chemical and materials engineering concepts (as applicable to degree type sought). The faculty can question the student about MS work and about course work completed previously.

PhD Preliminary Examination and Final Defense

The preliminary examination is the presentation of a research proposal in a form appropriate for a research-granting agency and that is related to the completion and extension of the PhD dissertation topic. The subject of the proposal is determined by the major professor, student and doctoral committee. The format for the proposal will vary; but should emphasize proposed work, approaches to the problem, and the potential for discovery of new concepts.

The written proposal is first submitted to the doctoral committee for review. After making the suggested revisions, the student and major professor will schedule an oral presentation, given on the Moscow campus, to both the committee and the Department faculty. It is customary to invite interested graduate students to attend as well. An open question and answer period will be conducted, followed by a closed session with the committee and Departmental faculty. The Department and committee may, at this time, consider other evaluative criteria and may wish to examine the student on any aspect of the PhD study plan. If the committee and department judge that the student has passed the PhD preliminary examination, he/she will be "advanced to candidacy" for the PhD degree. Finally, when the major professor decides that the graduate student is ready to defend his/her PhD dissertation, it should be known that the final defense will be held on the Moscow campus or by live video link from the Idaho Falls campus. The dissertation needs to be written according to the instructions provided at the COGS website. The expected duration of a PhD defense is around 40-50 min followed an extended question/answer session, first by the entire audience and then by committee and other interested faculty. A closed session of questioning proceeds the open defense presentation with only the graduate student's committee members and other interested graduate faculty.

While the PhD student needs to submit their approved dissertation to the COGS, it is recommended that by the time the PhD student is defending they will have published at least two journal papers with the potential for more being accepted after graduation.

Credit Requirement

The UI General Catalog requirements should always be referenced and followed, especially where the content herein is or appears to be outdated and/or in conflict with the current Catalog rules.

A minimum of 78 credits beyond Bachelor's degree is required; the degree audit study plan actually requires that exactly 78 credits be submitted and no more. Of these, 10 credits may be from master's thesis (500) and 20 course credits to satisfy master's degree plus 9 additional course credits above 501 (excluding 598-600 level courses), at least 30 PhD dissertation credits but not more than 45 (600), and the balance of the credits can be satisfied by taking courses in supporting areas. Included in these combined credits must be those three core-subject courses required per degree type for all students (viz., ChE 515, 529, 541 or MSE 507, 517, 525), which may not be offered every year as live lectures.

Some of the coursework completed during a Master's degree (see above) may also be counted toward the 78 credits for the PhD, up to a maximum of 30 credits. These would be similar or identical to those prescribed for the UI MS/ME degrees. A list of other graduate courses can also be taken as electives. For short descriptions, you may look up the University Catalog (http://www.uidaho.edu/registrar/classes/catalogs). Try the most recent year for up-to-date information. If you would like to know the course offerings in forthcoming/ongoing semester(s), go to http://www.uidaho.edu/schedule.

In addition to the above courses, the students can take a variety of courses from different disciplines such as Chemical Engineering, Mechanical Engineering, Nuclear Engineering, Physics, Chemistry, Business, Forest Resources and so forth. Students should consult with their major professors (and committee members as needed) for choosing the elective courses.

Student Outcome Evaluation

The learning outcomes are evaluated mainly in oral examinations as thesis defense. The students are scored from 1 to 5 points the interpretation of score is shown in the table below

1 = Poor; 3 = Good/Average, 5 = Excellent

The summary score of current graduates was tallied for each evaluator under each

Student Learning Outcome	Average Score	St.Dev.
Learn & Integrate:	3.9	0.7
Think & Create:	4.6	0.6
Communicate:	3.1	1.0

An ANOVA analysis was ran assuming individual student as a group and individual score as random replications. No significant difference in score was observed for students (n = 5) nor between evaluators. The data indicated that there is no system bias between evaluators.

The data shows that the students met the requirement is each of the categories.

Summary of Student Learning:

- The Ph.D. program in Chemical Engineering has well-defined learning objectives that are measured in several courses and during the final defense.
- The average score solidly met for all three learning objectives.
- There was no significant variance between evaluators in scoring student learning outcomes.

Summary of Faculty Discussion:

The Chemical and Biological Engineering faculty reviewed and discussed the learning outcomes for this program, both offline and during faculty meetings. The faculty approved the student outcomes and the way it is being evaluated.

Summary of Changes/Improvements Being Considered:

No changes are proposed for this program.

Inter-rater Reliability:

Although the program currently does not have inter-rater reliability assessment program. The scores from individual evaluation tested as random variable indicated that there was no statistically significant bias between evaluators.

Closing the Loop:

Not applicable for first year APR

Biological Engineering M.E.

Assessment Report Contact: Dev Shrestha

Program Changes in Past Year:

No program changes for M.S. in Chemical Engineering other than merging of the Chemical and Biological Engineering Departments.

Learning Outcomes are Communicated to All Students in Program (check box if true):

Learning Outcomes are Communicated to All Faculty (check box if true): false

Optional: Framework Alignment:

Import Outcomes Data (from Anthology Outcomes):

The graduate requirements for Biological Engineering are described in the BE graduate program handbook. This degree of Master of Engineering (M.E.) is meant primarily for students who are interested in more coursework without the research emphasis of the M.S. degree. Students on a research assistantship generally do not pursue a M.E. degree since research appointments require research work.

The learning outcome for M.E. program in Biological Engineering are:

1. **Knowledge Base**: An in-depth knowledge of the degree subject matter, integrating and building upon the foundation provided by a relevant undergraduate degree.
2. **Original Research / Design**: An ability to conduct original research and to appropriately and accurately analyze experimental data with insightful discussion.
3. **Communication Skills**: An ability to communicate findings in an appropriate format for disciplinary, interdisciplinary, and lay audiences, both orally and in writing.
4. **Global Citizenship**: An understanding impact of this project or research specifically, and of the responsibility to enhance the quality of life of the global community through the practice of engineering.

In order to meet the learning objectives, the students are required to meet the following requirements:

Major Professor and Committee

Each student in the M.E. degree program needs to have a major professor and a program of study committee.

During the first semester, the student will work with his/her major professor to select a program of study committee (the graduate committee). Normally, the major professor will be the person in charge of the program in which the student is interested. The major professor is the student's point of contact when questions arise about his/her study at BE.

The graduate committee consists of faculty members that can help the student prepare a plan for coursework in the field of interest. For the M.E. degree, the committee will normally consist of three persons including the major professor. In addition, the committee should include one other faculty member from the department and one from outside the department. For the purpose of this requirement, BE affiliated faculty members are considered in the department.

Study Plan

Preferably in the first semester but no later in the end of the second semester, the student has to develop a study plan consisting of coursework to be approved by the student's graduate committee. Generally, the study plan includes courses that fulfill the student's professional objectives. This study plan may include courses the committee or departmental graduate faculty regards as deficiencies. Examples are courses which are required for an undergraduate degree at UI but have not previously been taken by the student. The credits of these deficiencies do not count toward the degree requirements.

A minimum of 30 credits is required with at least 18 credits at the 500 level, among which, at least 9 credits have to be 500-level BE courses. These totals will not include courses taken to correct deficiencies. Courses that are required in the BE undergraduate curriculum cannot be used as part of the 30 credits required for the M.E. degree. Courses at the 300 level may be used only in supporting areas.

A paper or project corresponding to at least 3 credits of equivalent coursework taken as BE 502 is required. This paper or project requires the student to demonstrate that he/she is capable of independent and creative work. The topic of the paper or project has to be approved in advance by the student's major professor.

An overall grade point of 3.0 or above is required for graduation.

Final Examination

A final oral examination is required. The primary emphasis of the examination will be on the student's paper or project and on his/her coursework.

During the semester in which the requirements for the degree are expected to be completed, an oral examination will be requested by the student and conducted by the student's graduate committee. In this examination, normally two to three hours in length, the student will be required to defend his/her paper or project and answer questions on coursework.

The format for the final examination includes that the student prepares a brief presentation (20-30 minutes in length) summarizing his/her paper or project. This presentation can be open to the public depending on the decision of the student and graduate committee.

The committee may 1) pass the student with or without special conditions being attached, 2) require a re-examination at a later date, or 3) deny the degree. Appeal of a denial will follow current University of Idaho policies. Consult the College of Graduate Studies (www.uidaho.edu/cogs/) and/or the Dean of Students (uidaho.edu/student-affairs/dean-of-students) for academic appealing procedures in details.

Student Outcome Evaluation

The students are scored from 1 to 4 points by the major professor during the final examination. The interpretation of the score is shown in the table below

BE Student Learning Outcome	Assessment Rubric			
	Exceeds requirements Score:4	**Meets Requirements Score:3**	**Partially Meets requirements Score:2**	**Does Not Meet requirements Score:1**
1. Knowledge Base An in-depth knowledge of the degree subject matter, integrating and building upon the foundation provided by a relevant undergraduate degree.	Demonstrated a thorough knowledge of both breadth and depth of knowledge in discipline. Showed high level of competence in research area.	Demonstrated both breadth and depth of knowledge in discipline. Was competent in research area.	Demonstrated adequate depth in research area, but lacked breadth in discipline.	Did not demonstrate depth in research area.
2. Original Research / Design An ability to conduct original research and to appropriately and accurately analyze experimental data with insightful discussion.	Demonstrated extensive knowledge of published work in area of research and the ability to build on that knowledge. Showed ability to plan and execute original research and to analyze and correctly interpret the results.	Demonstrated adequate knowledge of published work in area of research and ability to build on that knowledge. Showed ability to execute original research and to analyze and correctly interpret the results.	Literature research was weak. Was able to conduct research and analyze and interpret the results under supervision.	Obviously missed many of the important works in the field. Research techniques and analysis weak.
3. Communication Skills An ability to communicate findings in an appropriate format for disciplinary, interdisciplinary, and lay audiences, both orally and in writing.	Thesis was well written using correct, clear and concise English with consistent format. Oral presentation showed good command of language and subject matter. Responses to questions were direct and provide the desired clarification. Excellent use of graphics.	Thesis was well written. Sentence structure and format generally resulted in "easy reading". Oral presentation was clear and concise. Responses to questions were generally concise and to the point. Graphics were appropriate.	Parts of the thesis were poorly written and/or format was inconsistent. Oral presentation was sometimes hard to follow and responses to questions did not always clarify the point.	Report was poorly written with and difficult to read. Inconsistent format. Poor oral presentation.
4. Global Citizenship An understanding impact of this project or research specifically, and of the responsibility to enhance the quality of life of the global community through the practice of engineering.	Provided a thoughtful analysis of the potential impact of the research, both intended (positive) and unintended (positive or negative), on society. Knew and understood issues involving ethics, sustainability and public health and safety related to research subject.	Provided a sound analysis of the potential impact of the research on society. Was knowledgeable of issues involving ethics, sustainability and public health and safety related to research subject.	Provided a weak analysis of the potential impact of the research on society or was not able to define ethical, sustainability or public health and safety issues.	Was not able to give a cogent analysis of societal context issues.

There are not enough students who graduated in the M.E. program recently to have meaningful student outcome data.

Summary of Student Learning:

- The M.E. program in Biological Engineering has well-defined learning objectives that are measured by the project report and oral presentations during the final defense.
- There are not enough students who graduated in the M.E. program recently to have meaningful student outcome data.

Summary of Faculty Discussion:

The Chemical and Biological Engineering faculty reviewed and discussed the learning outcomes for this program, both offline and during faculty meetings. The faculty approved the student outcomes and the way it is being evaluated.

Summary of Changes/Improvements Being Considered:

No changes are proposed for this program.

Inter-rater Reliability:

All faculty use the same rubrics and regular discussions are held.

Closing the Loop:

Not applicable for first year APR

Chemical Engineering M.E.

Assessment Report Contact: Dev Shrestha

Program Changes in Past Year:

No program changes for M.S. in Chemical Engineering other than merging of the Chemical and Biological Engineering Departments.

Learning Outcomes are Communicated to All Students in Program (check box if true): false

Learning Outcomes are Communicated to All Faculty (check box if true): true

Optional: Framework Alignment:

Import Outcomes Data (from Anthology Outcomes):

The graduate requirements for Chemical Engineering are described in the graduate program handbook. The graduate program assumes that the students are already well-grounded in the fundamentals of chemical engineering from their undergraduate education. The Student Learning Outcomes (SLO) of M.E. program are:

SLO1: Learn & Integrate: The student(s) will demonstrate expert engineering and science knowledge in a specialty field or subdiscipline.

SLO2 Think & Create: The student(s) will show capability to advance the frontier of knowledge in designated research area.

SLO3 Communicate: The student(s) will effectively communicate research results in oral and written form.

The Master of Engineering (M.E.) degree is a coursework-based degree and hence the final examination is not comparable to a thesis defense. However, it is designed to show that the student has mastered additional skills in the field of study (for ChE only; the MSE program currently offers a non-thesis MS and not the M.E. MSE degree) and critical thinking.

To meet the student learning outcome the M.E. Students take the required course as well as technical electives in their field of research. The general requirements for the M.E. program are:

Course	Credits
Electives	10
ChE 501 (Seminar ×2)	2
ChE 515 (Transport Phenomena)	3
ChE 529 (Chemical Engr. Kinetics)	3
ChE 541 (Chemical Engr. Analysis I)	3
ChE 5xx (elective)	3
Supporting or ChE electives	6
Total Credits	**30**

In addition to the coursework listed above, an additional 400-level (up to 12 credits that were not taken as deficiency courses, as outlined above) and 500-level course credits (numbered 502-597) must be taken to satisfy the 30-credit minimum for the degree. In contrast to the M.S. degree, CHE 500 credits are not acceptable, but 3-5 credits of CHE 599 (Non-thesis Master's Research) may be taken for the project culminating in the written review and oral presentation exam.

Final Exam Format

The exam is in two parts; a written review and an oral presentation. The student will be given a list of papers to review critically. He or she will then choose one of the papers and write a review of the paper and submit this to the examination committee. This committee will be selected by either the Department Chair or the Chemical and Materials Engineering coordinator in Idaho Falls. The committee will consist of two or more faculty or affiliate faculty. The written presentation should consist of an introduction stressing significance and summarizing related work including discussion, critique, and suggestions for extension of the work. The committee will evaluate the review, indicating approval or disapproval to the student. If the review is approved, the oral examination will then be scheduled. The oral exam will consist of a presentation of the written review. At the conclusion of the presentation, committee members may question the student on the review or any other topics relating to the student's graduate studies. At the end of the exam period, the committee will meet to determine if the student has passed the exam.

Review Paper Format

The format of the review paper is left to the discretion of the student and the examination committee. Any consistent style is acceptable as long as the paper is clear, concise, and legible. A suggested guide for the paper format may be obtained from The Chicago Manual of Style [16th Ed., The University of Chicago Press, available online or through the library] or similar publication. Following a good example review paper from one of the various recommended academic journals by the faculty would also be prudent. The review paper must be typed, double-spaced and free from any extensive errors, including typographical, grammatical, and formatting as well as technical content. The title and signature pages must be the first two pages of the review paper.

Student Outcome Evaluation

There are not enough students who graduated in the M.E. program recently to have meaningful student outcome assessment.

Summary of Student Learning:

- The M.E. program in Chemical Engineering has well-defined learning objectives that are measured by project report and oral presentations during the final defense.
- There are not enough students who graduated in the M.E. program recently to have meaningful student outcome data.

Summary of Faculty Discussion:

The Chemical and Biological Engineering faculty reviewed and discussed the learning outcomes for this program, both offline and during faculty meetings. The faculty approved the student outcomes and the way it is being evaluated.

Summary of Changes/Improvements Being Considered:

No changes are proposed for this program.

Inter-rater Reliability:

There are not enough students who graduated in the M.E. program recently to have meaningful inter-rater reliability analysis.

Closing the Loop:

Not applicable for first year APR

Student Achievement

Student Achievements

Student Retention:

Relevant data:

Student Status by Measures	Biological Engineering, B.S.	Chemical Engineering, B.S
Enrolled in Fall 2020	80	90
Enrolled in Fall 2020, Now Graduated	13	19
Continuing, BE Student	44	1
Continuing, ChE Student	1	43
Continuing, Not BE Student	12	
Continuing, Not ChE Student		16

From the data above, the following information was derived:

Biological Engineering enrolled 80 students in B.S degree in Fall of 2020. Since then, 13 students have graduated. From the remaining 67 BE students only 44 are re-enrolled in BE and 23 left the major. Out of 23, one student changed to ChE and 12 changed to other majors. Remaining 10 did not register or left the University. All in all, 22 out of 80 students left the major; 22 out of 80 is net attrition rate for BE is 28%.

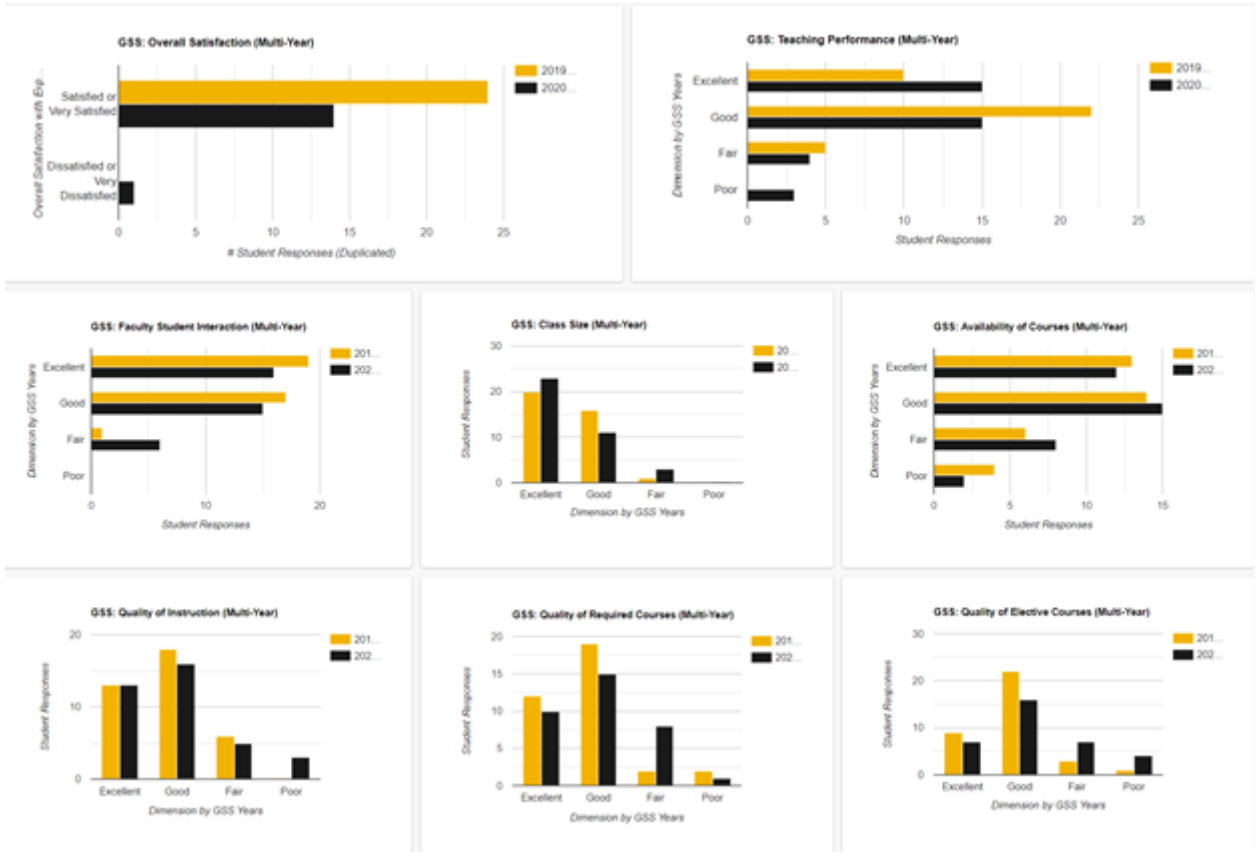
Student Retention rate for BE in 2020-2021 is 100(1-22/80) = 72%

Chemical Engineering enrolled 90 students in B.S degree in Fall of 2020. Since then, 19 students have graduated. From the remaining 71 ChE students only 43 are re-enrolled in ChE and 28 left the major. Out of 28, one student changed to BE, 16 changed to other majors, and 11 students did not register or left the University. All in all, 27 out of 90 students left the major; 27 out of 90 resulted in net attrition rate for ChE is 30%.

Student Retention rate for ChE in 2020-2021 is 70%

Student Experience

Below are the charts for Student’s experience metrics for Chemical and Biological Engineering



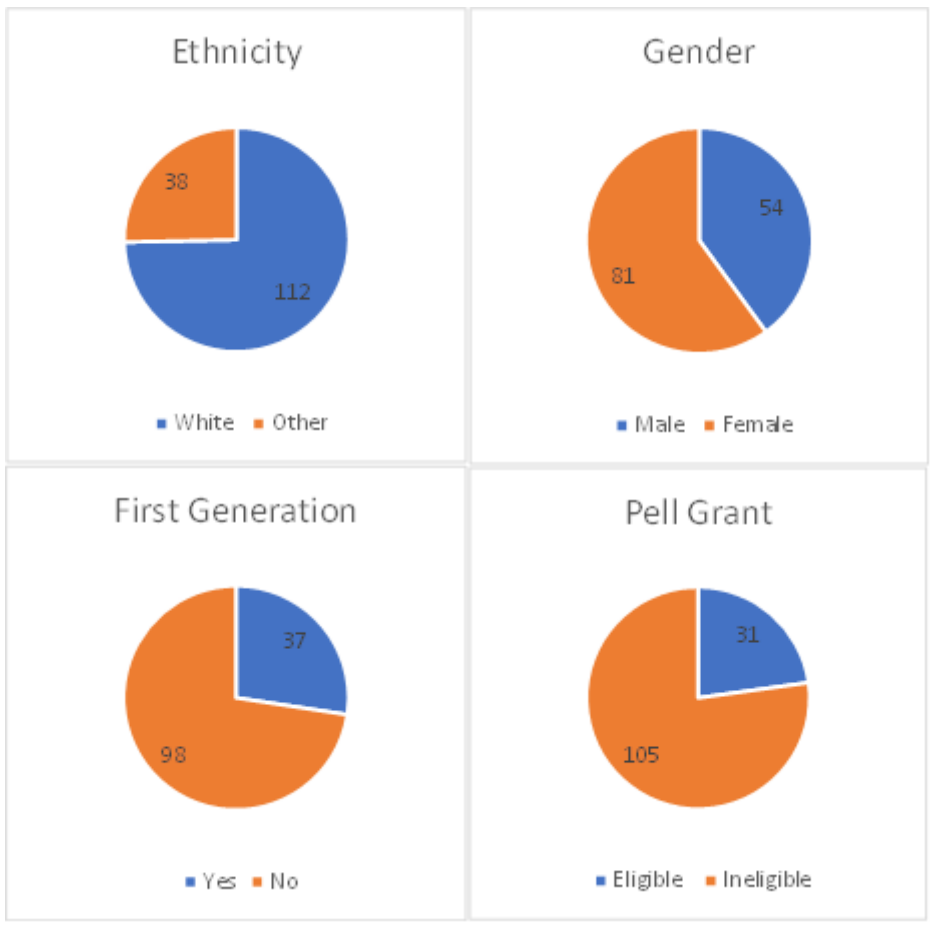
For the department as a whole, one hundred percent of students surveyed in the academic year 2019-2020 indicated they are satisfied or very satisfied with the program. Out of 15 students surveyed in 2020-2021, one student indicated dissatisfaction with Chemical Engineering. Overall there is no concern about student satisfaction with the program.

Most students ranked excellent to good for class size and mostly ranked excellent to good for faculty-student interaction as well.

The trend for quality of instruction, teaching performance, quality of required courses, and quality of required courses was similar. The mode of the distribution was for good followed by excellent. These are the areas that seem correlated. The department as a whole can focus on improving the overall quality of instruction to achieve excellent scores by the majority.

Student Demographics

The Chemical and Biological engineering students have the following composite demographics.



The department strives to maintain a supporting and positive environment for students from all backgrounds. The gender diversity in the department is 4:6 female to male ratio. 27% of the students are first-generation students and 23% of the students are Pell grant eligible.

Student Persistence:

Persistent students are those who are still with the university but did not return to the program.

Biological Engineering enrolled 80 students in B.S degree in Fall of 2020. Out of that 12 changed to other majors.

Student persistent rate in 2020-2021 is 100(1-12/80) =85%.

Chemical Engineering enrolled 90 students in B.S degree in Fall of 2020. Out of that 16 changed to other majors.

Student persistent rate in 2020-2021 is 100(1-16/90) =82%.

Student Completion:

Biological Engineering enrolled 80 students in B.S degree in Fall of 2020. Since then, 13 students have graduated and 55 are still enrolled. This means 13 out of 25 students graduated.

Student completion rate = 13/25 = 52%

Chemical Engineering enrolled 90 students in B.S degree in Fall of 2020. Since then, 19 students have graduated, 58 still enrolled. This means 19 out of 32 students graduated.

Student completion rate = 19/32 = 59%

Student Postgraduate Success:

Recent University of Idaho's first destination survey shows that average starting salary of Chemical and Biological Engineers is $92,722. According to Bureau of Labor Statistics, this profession has faster job growth than other engineering profession.

Identify Equity Gaps:

First generation students:

First Generation	UG GPA	Incoming GPA
Yes	2.73	3.41
No	3.32	3.61

The GPA difference between first-generation students is significantly less than non-first-generation students.

Gender:

	UG GPA	Incoming GPA
Male	3.16	3.44
Female	3.18	3.68

UG GPA difference among gender is not significant

Race:

Race	UG GPA	Incoming GPA
Unknown	2.96	3.54
Indian	3.07	3.38
Black	3.42	3.21
Hawaiian	3.17	3.71
White	3.23	3.53
Asian	3.05	3.75
Hispanic	2.57	3.42

Hispanic students have the lowest aggregate undergraduate GPA, although their incoming GPA is comparable.

From the data, it is evident that first-generation and Hispanic students are at risk of lagging behind in their education.

Effective Learning Environment and Closing Equity Gaps:

The first generation, Pell Grant eligible, and Hispanic students have lower than average GPA. The department will develop a system to monitor the at risk students to close the equity gap.

Demand and Productivity

Demand and Productivity

External Demand:

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The credit hours produced by the curriculum shows that 72% of the courses are for undergraduates and 28% for graduate students. This number closely matches the ratio of undergraduate and graduate students. The total credit hours produced in Fall of 2020 was 887, which was reduced to 673 in Fall of 2021. This is mainly due to the incoming smaller class size.

The department faculty teach classes that are also taken by out-of-the-department students. The credit hour demand for classes taught by Chemical and Biological Engineering faculty is shown below

	Total credit hours served	Internal Demand	External Demand*
Spring 2020:	1069		
Summer 2020:	38		

Fall 2020:	942	867	75
Spring 2021:	914	867	47
Summer 2021:	32		
Fall 2021:	724	673	51

Total credit hours served in the year 2020 = 2049

Total credit hours served in the year 2021 = 1670

The external demand in 2021 is 126 credit hours which is about 6.1 % of the total credit hours produced by the department.

*External demand was calculated by subtracting the internal demand from the total credit hours served.

Internal Demand:

Chemical Engineering and Biological Engineering are more specialized areas of engineering that require more science courses compared to other engineering disciplines. As a result, the engineering courses taught by the Chemical and Biological Engineering department are more specialized and therefore the majority of credit hours produced is from internal demand.

Credit Productivity:

There are 12 faculty in the department with an aggregate of 4.99 teaching FTE equivalent.

The average credit hours produced per FTE for 2020 is 411 and in 2021 is 335.

About 900 credit hours per semester of internal demand is fulfilled by 4.99 teaching FTE. This translated to producing about 360 credits hours per teaching FTE.

Financial Health and Resources

Financial Health and Resources

Financial Health:

The department has few funding sources for day-to-day operations and some development funds. These funds are briefly outlined below for the fiscal year 2022.

Gen Ed: $18,700 (does not include faculty and staff salaries)

This budget is used for general expenses running the department related to instructional needs, including office supplies, printer maintenance, background check for TA's, temporary help for graders, travel related to teaching enhancements and, some software licenses. The funding level is adequate for day-to-day expenses.

Gift Funds: $140,000

The department has about $140,000 in gift account endowment funds. These funds are divided into two parts, the development fund and restricted funds. The development funds and specific donor-supported endowment funds are for the development of the department. Some of these funds have restrictions on how they can be used. An unrestricted gift is what is considered a general development fund for the department. The general funds are used for mainly developing the facilities and maintenance of facilities such as meeting rooms, student lounge, and investment in technology. Restricted funds are used as specified in the endowment documents.

Departmental F&A Return: $ 13,565 Carryover + $28,890.50 for FY 2021

Chemical and Biological Engineering is one of the research-heavy departments in the college. Out of the current 12 FTE, The department has 4.96 FTE (3.01 in BE and 1.95 in ChE) equivalent for Scholarship in Position Descriptions. For the FY2021, the department netted $28,890.50 in F&A return. The total F&A collected by the University is distributed in the following manner:

50% Central, 25% College(s) of PI(s), and 25% Institute.

Of the amount the College of Engineering receives, 60% remains in college, 20% goes back to the PI, and 20% to the PI's department. Chemical and Biological Engineering has generated 37% of all college F&A return. This is a significant amount considering the total FTE vested in the scholarships.

The F&A return money is invested back in enhancing the research capability of the department. This includes repair and maintenance of general research facilities, research software license not specific to a grant, paying for health insurance and other miscellaneous expenses for Teaching Assistants, and covering publication fees not covered under grants.

Course Fees: $38,704.46

The course fees are used mainly for laboratory consumables and to enhance student learning.

Teaching Assistant Support

The department has five Teaching Assistant positions funded by the College of Graduate Studies. The COGS pays for their stipend, and tuition, and fees. The department covers their Student Insurance through UI SHIP. The level of TA support is adequate for the department.

In general, there is enough support for basic needs for the department. However, there is not enough support for:

1. Upgrading and keeping up with new technologies for the teaching labs. The equipment used in Chemical and Biological Engineering is expensive. The facilities and tools used in teaching labs are several decades old. Funding is needed to bring the labs up to today's industry-standard practices.
2. Support for research lab technical support. The equipment used in Chemical and Biological Engineering labs is usually advanced and delicate. They need a specially trained technician to maintain and run. The department has one technical support staff member. An additional technician specialized in biological and chemical engineering lab equipment would greatly enhance the research capability of the labs.

Efficient Use of Resources:

The merged department of Chemical and Biological engineering is pooling resources to develop an integrated lab space for teaching and research. The faculty members in the department are collaborating in the area of biomedical, environmental and energy engineering areas to best utilize and share resources. They share space, equipment, and technical knowledge.

The department maintains an inventory of its equipment. The faculty has access to this document to search for a particular instrument for shared use.