

Academic Year 2025-2026

BS in Chemical Engineering - BS-CHEN Learning Outcomes

An ability to identify, formulate, and solve complex engineering probl **MET**

An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
Description:

This outcome measures the ability of students to analyze an open ended problem, identify conflicting technical issues and then appropriately apply engineering, science and math to propose a result that incorporates elements of optimization.

Course:

CHEN 3311 Momentum Transfer

Assessment Instrument:

Semester Project

CHEN 4320 Mass Transfer

Assessment Instrument:

Design Project

Outcome Categories:

1. Identifies and Formulates Complex Problems
2. Can solve problems with conflicting technical issues
3. Appropriately applies math, engineering, and science to achieve a solution

75% of students should show satisfactory performance.

MEASURES	RESULTS	ACTIONS
Identifies and Formulates Complex Problems Can convert an open-ended problem with no obvious solution into a quantitative problem statement by applying engineering, mathematical, and scientific theory, but may be in a way that produces sub-optimal results. Direct - Assignment <i>Momentum Transfer: CHEN 3311</i> Target 75% of the students will meet expectations	MET Identifies and Formulates Complex Problems ■ Met ■ Not Met  0% 100% Met: 93% Not Met: 7% Met Total: 93% Not Met Total: 7%	<i>No actions have been added.</i>
Can solve problems with conflicting technical issues Can find a reasonable solution to an open-ended problem with conflicting technical issues, even if optimization is somewhat limited. Direct - Assignment <i>Momentum Transfer: CHEN 3311</i> Target At least 80% of students meet expectations	MET Can solve problems with conflicting technical issues ■ Met ■ Not Met  0% 100% Met: 93% Not Met: 7% Met Total: 93% Not Met Total: 7%	<i>No actions have been added.</i>
Appropriately applies math, engineering, and science to achieve a solution	MET Appropriately applies math, engineering, and science to achieve a solution	<i>No actions have been added.</i>

The solution method to the complex problem uses the correct theory from math, engineering, and science, but some theoretical or computational errors are allowable Direct - Assignment Momentum Transfer: CHEN 3311 Target At least 80% of students meet expectations		
	0%	100%
	Met:	79%
	Not Met:	21%
	Met Total:	79%
	Not Met Total:	21%

Conclusion

Performance Indicator 1a This PI required students to convert an open-ended problem with no obvious solution into a quantitative problem statement by applying engineering, mathematical, and scientific theory. This was assessed in CHEN 3311 and CHEN 4320

Performance Indicator 1b In this PI, students were expected to find a reasonable solution to an open-ended problem with conflicting technical issues, even if optimization is somewhat limited.

Performance Indicator 1c. This PI asks students to appropriately apply math, engineering and science to achieve a solution method to a complex problem.

All performance indicators met expectations. Several changes were made since the last assessment that may have helped improve performance.

An ability to apply engineering design to produce solutions **MET**

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.

Description:
This outcome measures the student's ability to create a capstone design project will considering important design and ethical factors

Course:
CHEN 4340 Plant Design II

Assessment Instrument:
Capstone Project Project

Outcome Categories:

- 1. Meets specific needs
- 2. Considers public health
- 3. Considers safety
- 4. Considers welfare
- 5. Considers global factors
- 6. Considers cultural factors
- 7. Considers social factors
- 8. Considers environmental factors
- 9. Considers economic factors

75% of students should show satisfactory performance.

MEASURES	RESULTS	ACTIONS
Meets Specific Needs The project meets most of the specific needs and requirements of the design specifications while respecting most of the design constraints. Direct - Presentation Plant Design II: CHEN 4340 Target		No actions have been added.

At least 75% of students meet expectations	Met: 100% Met Total: 100% Not Met Total:	
Considers Public Health Public health was adequately considered in the context of their unique design solution Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Considers Public Health ■ Met  0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	No actions have been added.
Considers Safety Safety was adequately considered in the context of their unique design solution Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Considers Safety ■ Met  0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	No actions have been added.
Considers Welfare Welfare was adequately considered in the context of their unique design solution Direct - Other <i>Plant Design II: CHEN 4340</i> Target Considers Welfare	MET Considers Welfare ■ Met  0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	No actions have been added.
Considers Global Factors	MET Considers Global Factors	No actions have been added.

The global effects of the project were adequately considered in the context of their unique design solution Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	Met  0%100% <i>Values are not shown when too close to each other. Click or use arrow keys to see details.</i> Met: 100% Met Total: 100% Not Met Total:	
Considers Cultural Factors The cultural effects of the project were adequately considered in the context of their unique design solution Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Considers Cultural Factors Met Not Met  0%100% Met: 81% Not Met: 19% Met Total: 81% Not Met Total: 19%	<i>No actions have been added.</i>
Considers Social Factors The social effects of the project were adequately considered in the context of their unique design solution Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Considers Social Factors Met Not Met  0%100% Met: 81% Not Met: 19% Met Total: 81% Not Met Total: 19%	<i>No actions have been added.</i>

Considers Environmental Factors The environmental effects of the project were adequately considered in the context of their unique design solution Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Considers Environmental Factors ■ Met  0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	<i>No actions have been added.</i>
Considers Economic Factors The economic effects of the project were adequately considered in the context of their unique design solution Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Considers Economic Factors ■ Met  0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	<i>No actions have been added.</i>

Conclusion

Performance Indicators 2b – 2h. These PIs are assessed in the capstone project report's "checklist" section that asks students to describe how their project considers public health (2b), safety (2c), welfare (2d), global factors (2e), cultural factors (2f), social factors (2g), environmental factors (2h) and economic factors (2i). These PIs were assessed by the Outcome Assessment Team.

All PIs met expectations and no action items are required.

An Ability to Communicate with a Range of Audiences **MET**

An Ability to Communicate with a Range of Audiences

Description:

This outcome measures a students ability to communicate to a technical, non-technical audience in written form as well as to communicate orally and through a poster.

Course:

CHEN 4340 Plant Design II

Assessment Instrument:

Capstone Project Project, poster and oral presentation

Outcome Categories:

1. Report Communication
2. Ability to communicate to a technical audience
3. Ability to communicate to a non-technical audience
4. Poster communication
5. Oral communication

MEASURES	RESULTS	ACTIONS
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Report Communication Report contains all required information with minimal writing errors per page. Sample calculations are correct and explained. Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Report Communication ■ Met  0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	No actions have been added.
Ability to communicate to a technical audience The communication is comprehensible and appropriate to academic, industrial, and technical people in the field. Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Ability to communicate to a technical audience ■ Met  0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	No actions have been added.
Ability to communicate to a non-technical audience The communication is comprehensible and appropriate to a non-technical audience. Direct - Other <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Ability to communicate to a non-technical audience ■ Met  0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	No actions have been added.
Poster Communication Figures and tables are appropriately formatted, referenced, legible and explained with minimal errors. References are complete and appropriate	MET Poster Communication ■ Met 	No actions have been added.

Direct - Presentation <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	
Oral Communication Group presentation can be up to 2 minutes longer or 4 minutes too shorter than assigned duration. Up to one of the following can be lacking: Good eye contact, use of proper American English, appropriate response to questions and general professionalism (appropriate attire, etc.). Direct - Presentation <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Oral Communication ■ Met 0% 100% Values are not shown when too close to each other. Click or use arrow keys to see details. Met: 100% Met Total: 100% Not Met Total:	No actions have been added.

Conclusion

Performance Indicator 3a. This PI asks students to use proper report communication (e.g. appropriate writing, grammar, well-formatted calculations) in the capstone project written report. This PI is assessed by the Outcome Assessment Team (OAT) by examining several sample pages out of the report and analyzing for errors.

Performance Indicator 3b. This PI assesses the students' ability to communicate to a technical audience. This PI is assessed by the OAT by examining several sample pages out of the report and analyzing the technical content for appropriate language and clarity.

Performance Indicator 3c. This PI assesses the students' ability to communicate to a non-technical audience. This PI is assessed by the OAT by examining the abstract of the poster presentations, which were supposed to be written for a more general audience (e.g. a wide range of people attending the senior design symposium).

Performance Indicator 3d. This PI assesses the student's ability to properly create a poster presentation with the proper formatting (e.g. figures, tables, captions, etc.) and technical information. The assessment was done by the OAT examining the students' posters for the senior design symposium

Performance Indicator 3e (2024 – 2025). In this PI, Students were required to give oral presentations about their capstone design projects and to keep the presentation within the specified time limits, use eye contact, proper English and to present and respond to questions in an appropriate and professional manner. This was assessed by volunteer faculty who could attend the student presentations.

All performance indicators met expectations and no action items are required.

An ability to recognize ethical and professional responsibilities **MET**

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.

Description:

This outcome describes the student's ability to create a capstone design project will considering important effects of engineering design and ethical implications

Course:

CHEN 4360 Plant Design I

Assessment Instrument:

Semester report

Outcome Categories:

1. Recognizes ethical and professional responsibilities

2. Understands the global effect of engineering solutions
3. Understands the economic effect of engineering solutions
4. Understands the environmental effect of engineering solutions
5. Understands the societal effect of engineering solutions

MEASURES	RESULTS	ACTIONS
Recognizes ethical and professional responsibilities Is aware of the ethical and professional responsibilities of an engineer and mostly makes informed engineering judgement Direct - Assignment <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Recognizes ethical and professional responsibilities ■ Met ■ Not Met  0% 100% Met: 90% Not Met: 10% Met Total: 90% Not Met Total: 10%	<i>No actions have been added.</i>
Understands The global effect of engineering solutions Is aware of how their ethical and professional judgement leads to engineering solutions that could have an effect at the global scale. Direct - Assignment <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Understands The global effect of engineering solutions ■ Met  0% 100% <i>Values are not shown when too close to each other. Click or use arrow keys to see details.</i> Met: 100% Met Total: 100% Not Met Total:	<i>No actions have been added.</i>
Understands the economic effect of engineering solutions Is aware of how their ethical and professional judgement leads to engineering solutions that could have an economic effect. <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Understands the economic effect of engineering solutions ■ Met  0% 100% <i>Values are not shown when too close to each other. Click or use arrow keys to see details.</i> Met: 100% Met Total: 100% Not Met Total:	<i>No actions have been added.</i>

Understands the environmental effect of engineering solutions Is aware of how their ethical and professional judgement leads to engineering solutions that could have an environmental effect. Direct - Assignment <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Understands the environmental effect of engineering solutions ■ Met  0% 100% <i>Values are not shown when too close to each other. Click or use arrow keys to see details.</i> Met: 100% Met Total: 100% Not Met Total:	<i>No actions have been added.</i>
Understands the societal effect of engineering solutions Is aware of how their ethical and professional judgement leads to engineering solutions that could have a societal effect. Direct - Assignment <i>Plant Design II: CHEN 4340</i> Target At least 75% of students meet expectations	MET Understands the societal effect of engineering solutions ■ Met ■ Not Met  0% 100% Met: 90% Not Met: 10% Met Total: 90% Not Met Total: 10%	<i>No actions have been added.</i>

Conclusion

Student Outcome 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.

Performance Indicators 4a-e. These PIs use an “impacts memo” assignment in CHEN 4340 (Plant Design II) to assess a students ability to recognize ethical and professional responsibilities (4a, memo introduction), understand the global effects of engineering solutions (4b, memo global effects section), understand the economic effects of engineering solutions (4c, memo economic effects section), understand the environmental effects of engineering solutions (4d, memo environmental effects section) and understand the societal effects of engineering solutions (4e, memo societal effects section).

All PIs met expectations and no action items are needed.

An ability to function effectively on a team **MET**

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.

Description:

This outcome measures the student's ability to collaborate, set goals and work in a team

Course:

CHEN 4310 Laboratory I

Assessment Instrument:

Semester Project Project

Outcome Categories:

1. Planning and participation
2. Collaborating, inclusiveness and sharing
3. Establishes goals and objectives
4. Leadership and teamwork

MEASURES	RESULTS	ACTIONS
Planning and Participation Routinely present at team meetings or work sessions. Contributes a fair share to the project workload. Is prepared for the group meeting with clearly formulated ideas. Direct - Other <i>Laboratory I: CHEN 4310</i> Target At least 75% of students meet expectations	MET Planning and Participation ■ Met ■ Not Met  0% 100% Met: 78% Not Met: 22% Met Total: 78% Not Met Total: 22%	No actions have been added.
Collaboration, inclusiveness and sharing Shares credit for success with others and accountability for team results. Shares information with others and aids others Direct - Other <i>Laboratory I: CHEN 4310</i> Target At least 75% of students meet expectations	MET Collaboration, inclusiveness and sharing ■ Met ■ Not Met  0% 100% Met: 81% Not Met: 19% Met Total: 81% Not Met Total: 19%	No actions have been added.
Establishes goals and objectives Goals and objectives are created, but minor deficiencies in some critical components such as clarity, attainability, or incomplete planning in the planning stage is acceptable. Direct - Other <i>Laboratory I: CHEN 4310</i> Target At least 75% of students meet expectations	MET Establishes goals and objectives ■ Met ■ Not Met  0% 100% Met: 91% Not Met: 9% Met Total: 91% Not Met Total: 9%	No actions have been added.
Leadership and teamwork The team establishes a leadership structure, but some ambiguity of responsibility is acceptable. Some minor lapses in teamwork are acceptable.	MET Leadership and teamwork ■ Met ■ Not Met 	No actions have been added.

Direct - Other		
Laboratory I: CHEN 4310	0%	100%
Target	Met: 88%	
	Not Met: 12%	
At least 75% of students meet expectations	Met Total: 88%	
	Not Met Total: 13%	

Conclusion

Student Outcome 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.

Performance Indicator 5a. This PI analyzes the student's ability to plan and participate in experiments by assessing their attendance, effort sharing and being adequately prepared for group meetings and having well-prepared ideas. The assessment is done by direct observation by the instructor (attendance record) and student peer-reviews of their teammates.

Performance Indicator 5b. This PI assesses the students' ability to collaborate, share and be inclusive by documenting their ability to share credit and information with others, take accountability for team results, and help team members. The metrics used were direct observation by the instructor during lab sessions, student surveys and oral presentation evaluations.

Performance Indicator 5c. This PI assesses the students' ability to establish goals and objectives by assessing how goals and objectives were created with respect to clarity, attainability and completeness. The metrics used were direct observation by the instructor during lab sessions, student surveys and oral presentation evaluations.

Performance Indicator 5d. This PI assesses the students' leadership and teamwork by examining how the teams establish a leadership structure and participate in teamwork. The metrics used were direct observation by the instructor during lab sessions, student surveys and oral presentation evaluations.

All PIs met expectations and no action items are needed.

An ability to develop and conduct appropriate experimentation **MET**

An ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgement to draw conclusions.

Description:

This outcome measures the student's ability to perform experiments, document and understand the data and use theory to interpret the results

Course:

CHEN 4310 Laboratory I

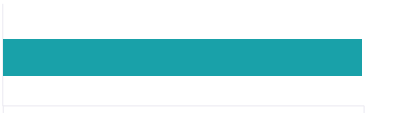
Assessment Instrument:

Laboratory reports

Outcome Categories:

1. Develop and conduct experiments
2. Analyze and interpret data
3. Use engineering judgement to draw conclusions

MEASURES	RESULTS	ACTIONS
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Develop and conduct experiments Unsafe lab procedures are infrequently observed. Data is documented but may have some minor lapses in documentation. Needs only some or limited guidance in operating equipment and instrumentation (E&I) Direct - Assignment Laboratory I: CHEN 4310 Target At least 75% of students meet expectations	MET Develop and conduct experiments ■ Met  0% 100% <i>Values are not shown when too close to each other. Click or use arrow keys to see details.</i> Met: 100% Met Total: 100% Not Met Total:	No actions have been added.
Analyze and interpret data Applies appropriate theory to data but some misinterpretation of physical significance is allowed. No to minimal unit errors. Is aware of measurement error and accounts for it, but some errors in application may be observed. Seeks information for experiments from a few sources or more. Direct - Assignment Laboratory I: CHEN 4310 Target At least 75% of students meet expectations	MET Analyze and interpret data ■ Met ■ Not Met  0% 100% Met: 81% Not Met: 19% Met Total: 81% Not Met Total: 19%	No actions have been added.
Use Engineering judgement to draw conclusions The conclusions are appropriate, but minimal aspects of engineering fundamentals not being properly expressed or explained is allowable. Direct - Assignment Laboratory I: CHEN 4310 Target At least 75% of students meet expectations	MET Use Engineering judgement to draw conclusions ■ Met  0% 100% <i>Values are not shown when too close to each other. Click or use arrow keys to see details.</i> Met: 100% Met Total: 100% Not Met Total:	No actions have been added.

Conclusion

Performance Indicator 6a. This PI assesses the students' ability to develop and conduct experiments by analyzing their ability to carry out safe lab procedures, adequately document their data and effectively operate equipment and instrumentation. The assessment was performed by the

instructor and the tools used were the data collection portions of the laboratory reports and observation by the instructor regarding safety and safety training.

Performance Indicator 6b. This PI assesses the students' ability to analyze and interpret data by determining how well they apply theory to data, interpret the physical significance of data, recognize and account for measurement error and seek additional information about the experiments from external sources. The assessment was performed by the instructor and the tools used were the laboratory reports with a focus on the data presentation and interpretation sections.

Performance Indicator 6c. This PI assesses the students' ability to use engineering judgement to draw conclusions by determining if their conclusions are appropriate and engineering fundamentals were appropriately applied to reach the conclusions. The assessment was performed by the instructor and the assessment tool was the lab reports, with a focus on the calculations and conclusions sections.

All PIs met expectations and no action items are required.

an ability to acquire and apply new knowledge as needed **MET**

an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Description:

This outcome measures the student's ability to identify the need to and independently find information outside of the classroom environment and apply it to solve open ended problems.

Course:

CHEN 4350 Advanced Analysis

Assessment Instrument:

Semester Project

CHEN 3311 Momentum

Assessment Instrument:

Design Project

Outcome Categories:

1. Ability to prepare projects using new knowledge from up-to-date materials found outside of class
2. Ability to apply appropriate learning and research strategies to solve open ended problems
3. Recognize the need to acquire new knowledge

MEASURES	RESULTS	ACTIONS
Ability to prepare projects using new knowledge from up-to-date materials found outside of class The students were able to find the required information from relevant and up to date sources from outside of class. Direct - Assignment <i>Momentum Transfer: CHEN 3311</i> Target At least 75% of students meet expectations	NOT MET Ability to prepare projects using new knowledge from up-to-date materials found outside of class ■ Met ■ Not Met 0% 100% Met: 55% Not Met: 45% Met Total: 55% Not Met Total: 45%	<i>No actions have been added.</i>
Ability to apply appropriate learning and research strategies to solve open ended problems Can apply appropriate learning and research strategies to solve open ended problems. The solution/conclusion is logical with convincing, minor insufficiencies in evidence are allowed. Direct - Assignment	MET Ability to apply appropriate learning and research strategies to solve open ended problems ■ Met ■ Not Met 0% 100%	<i>No actions have been added.</i>

<i>Momentum Transfer: CHEN 3311</i> Target At least 75% of students meet expectations	Met: 75% Not Met: 25% Met Total: 75% Not Met Total: 25%	
Recognize the need to acquire new knowledge Identifies the need for acquiring new knowledge. Some vagueness in implementation strategies is allowable. Direct - Assignment <i>Momentum Transfer: CHEN 3311</i> Target At least 75% of students meet expectations	MET Recognize the need to acquire new knowledge ■ Met ■ Not Met  0% 100% Met: 86% Not Met: 14% Met Total: 86% Not Met Total: 14%	<i>No actions have been added.</i>

Conclusion

Student Outcome 7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Performance Indicator 7a. This PI assesses the students' ability to prepare projects using new knowledge from up-to-date materials found outside of class by examining the project content and references for accurate and recent information from materials not available in the course curriculum. The assessment was conducted by the instructor and the assessment tool was the semester project.

Performance Indicator 7b. In this PI students were asked to apply appropriate learning and research strategies to solve open-ended problems. The assessment tool was the semester project and the sections assessed were the calculations and design equations.

Performance Indicator 7c. In this PI, students were supposed to show evidence that they Identified the need for acquiring new knowledge. The assessment tool was the semester project and the assessment was based on evidence of using tools used beyond the classroom instruction.

PI 7a was not met. An action item will be created to address the ability of student's to use up-to-date materials outside the classroom. Namely, a primer on using AI tools for engineering applications will be introduced, as well as information about numerous simulation software packages that aren't normally covered as course curriculum.