Biaglow, Andrew Dr.

From: Armstrong, Matthew LTC
Sent: Monday, April 19, 2021 7:59 AM
To: Kevin Shipe; Hair, Lucy Marie; Kisondra Waters; Donald Glaser; Matthew Garvey; Kelly Schultz; Lynn Walker; Liberatore, Matthew; patrick.nonhof@provenanceconsulting.com; garitch@cvzoom.net; mike@smkpackaging.com; Hill, Aaron T COL; Patrick Underhill
Cc: Biaglow, Andrew Dr.; Nagelli, Enoch Dr.; Cowart, Samuel V LTC; James, Corey LTC
Subject: Chem E ABET Advisory 2021
Attachments: AY21 Advisory Board Surveys.pdf; Program Assessment Data - 6 October 2020.pdf; Exec Summary 19APR21.pdf; Advisory Board 22-23APR21 16APR21 Draft.pdf

ABET Advisory Team,

We went through the NOV2020 ABET reaccreditation with no shortcomings, and will be adding 2x new bioengineering electives. Please see executive summary, and the attached full ABET Advisory slide show for more information.

We will not be meeting in person this year, and the virtual meeting is canceled. However I am free to set up individual meetings with each of you to go over the data pack, and the slides, etc. as well as to answer any questions.

We thank you for your service over the years, and are asking you to fill out the attached survey and return by Friday, 23APR2021.

Please contact me if there are any questions or comments.

Thank you,

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Chemical Engineering Program Director
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Go Army Chem E!

Name:_____ Date:_____

2021 Advisory Board Surveys

Welcome to our annual advisory board meeting. As you know, we consider each of you to be valued shareholders in our program. The meeting is our annual shareholder's meeting, where we show you our performance report and discuss methods of improving the program. This document is your official advisory board survey, and it is *extremely important to our program.* It is designed to do two things. First, the completed surveys provide *documentation* that you have been briefed on the performance of our cadets and the relevance of the program objectives. This is extremely important for maintaining our accreditation. Second, it allows us to use your collective knowledge and experience to *identify areas* where we might be in need of improvement. The surveys are based in part on the data that we present to you during this meeting, and your responses are your "thumbs up or down" to the various performance indicators we are tracking. This survey is part of the assessment for *Academic Year 2020* (cadets who graduated in May 2020).

Instructions

- The survey pertains to student outcomes (Part I), program educational objectives (Part II), and program improvement (Part III). You will be given time during the day to answer the questions.
- For Part I, use the data to evaluate the attainment of our student outcomes. You will also meet with cadets, and the opinions you form of them might also influence your ratings. It is completely appropriate to use that information in the formation of your opinions.
- Part II pertains to the relevance, consistency, and cadet awareness of the program educational objectives. Your opinions and our discussions will help shape future revisions of these objectives.
- Part III contains some free-form questions where you can comment on the quality of the curriculum, the meeting itself or any other items you would like us to address.
- The survey is electronically fillable. Use the tab key to step though the form.
- *The surveys are due by the end of today, 23 April 2021 or as soon as possible.* If you complete the survey after you leave, please email the electronic survey or mail the physical copy to us as soon as possible.

Name:_____ Date:_____

The mission of the chemical engineering program is to prepare commissioned leaders of character who are proficient in applying chemical and engineering principles to solve problems in a complex operational environment.

Chemical Engineering Program Objectives: During a career as commissioned officers in the United States Army and beyond, program graduates:

- Demonstrate effective leadership and chemical engineering expertise.
- Contribute to the solution of infrastructure or operational problems in a complex operational environment.
- Succeed in graduate school or other advanced study programs.
- Advance their careers through clear and precise technical communication.

Chemical Engineering General Program Outcomes (Outcomes 1-7): On completion of the chemical engineering program, our graduates demonstrate an ability to:

- [Student Outcome 1] Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- 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.
- Communicate effectively with a range of audiences.
- 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.
- Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- Acquire and apply new knowledge as needed, using appropriate learning strategies.

Chemical Engineering Curriculum Outcomes (Outcome 8): The program provides the graduate with a thorough grounding and working knowledge of the chemical sciences, including:

- Chemistry
- Material and energy balances
- Safety and environmental factors
- Thermodynamics of physical and chemical equilibria
- Heat, mass, and momentum transfer
- Chemical reaction engineering
- Continuous and staged separation operations
- Process dynamics and control
- Modern experimental and computing techniques
- Process design

Name:_____ Date:_____

Part I. Student Outcomes. Review the data and then check the box in the column that most closely represents your opinion.

The cadets in the program are able to:	Strongly Disagree		Neutral		Strongly Agree
• Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.					
• 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.					
• Communicate effectively with a range of audiences.					
• 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.					
• Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.					
• Develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.					
• Acquire and apply new knowledge as needed, using appropriate learning strategies.					
• Have attained a thorough grounding in and working knowledge of the chemical engineering curriculum.					

Make sure to provide one response per row.

Name:_____ Date:_____

Part II. Program Objectives. Check the box that most closely represents your opinion.

	Strongly Disagree		Neutral		Strongly Agree
The program objectives are consistent with the USMA mission.					
The program objectives are consistent with the needs of the Army.					
The program curriculum supports the program objectives.					
The student outcomes are consistent with the program mission and objectives.					
The program has a process for periodically assessing the achievement of its student outcomes.					
The survey methods used by the program are effective.					
The cadets in the program are aware of the program objectives.					
The cadets are given an opportunity to provide their opinion about the program objectives.					
The cadets are satisfied with the courses in the program.					
The faculty are aware of the program objectives.					
The faculty are given an opportunity to provide their opinion about the program objectives.					

Make sure to provide one response per row.

Name:_____ Date:_____

Part III. Open Questions. Answer the questions below or provide other input as desired.

Based on the assessment data or on your personal opinion, is there a course that the program should add to the curriculum? Please explain.

Do you have any suggestions to improve the advisory board meeting for next year?

Please add any addition comments that you would like to make below.

PROGRAM ASSESSMENT DATA AY2020

UNITED STATES MILITARY ACADEMY
DEPARTMENT OF CHEMISTRY AND LIFE SCIENCE
CHEMICAL ENGINEERING PROGRAM
October 6, 2020

Note: When complete, the results of the surveys are summarized in the "Evaluations" section. The evaluation section is a working draft as of October 6, 2020. Faculty data is complete and up to date. Advisory board assessment is not available until late spring 2021 after the advisory board meeting.

Level of Achievement of Student Outcome 1:

On completion of the chemical engineering program, our graduates will be able to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. Fundamentals of Engineering Examination, once/yr.
3. End-of-Semester Student Surveys, once/semester.
4. Chemical Engineering Program Exit Survey, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

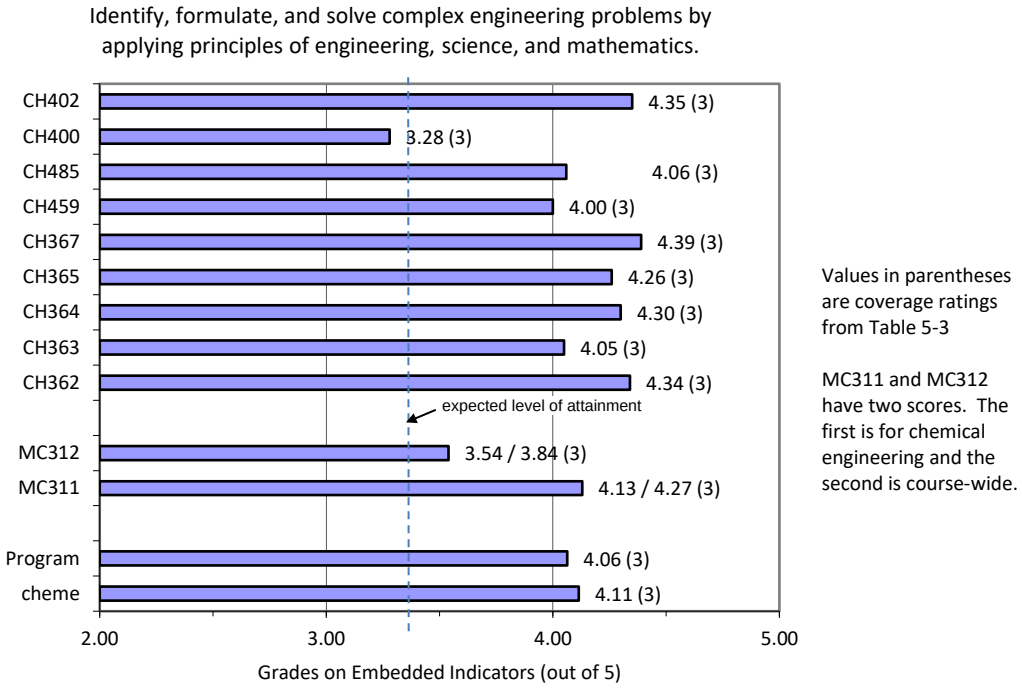

Figure 1-1. Coursework Embedded Indicator results for Student Outcome 1.

2. Fundamentals of Engineering Examination (FEE). According to the 2020 report from NCEES, 7 out of 9, or 77.8% of the students in the Class of 2020 took and passed the FE Exam. The national average in 2020 was 74.6%, and this is our expected level of attainment. In the previous five years, the pass rates were 100% in 2019, 85.7% in 2018, 93.8% in 2017, 79.2% in 2016, and 76.2% in 2015. Our running average over those five years is 87% ± 10% (79% ± 6% for the national).
   Note: We are **above** the national average for the pass rate for the past six years, and the national average is our expected level of attainment.

3. End of Semester Student Surveys

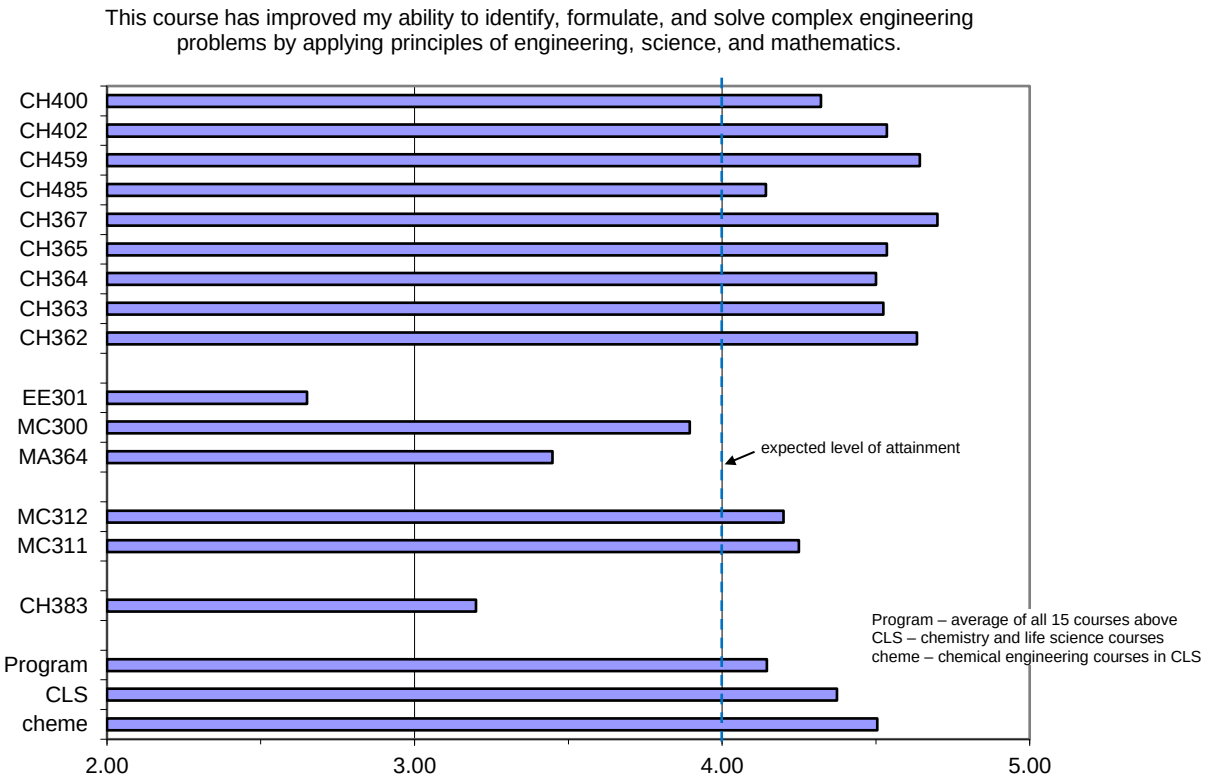

Figure 1-2. End-of-Semester Student Survey responses for Student Outcome 1.

4. Chemical Engineering Program Exit Survey. This survey is issued to the firsties at the end of their last semester. In this question, they were asked whether they agree with the statement "The program has prepared me to Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics." 29 out of 29 cadets completed the survey. All 29 cadets said that they either agreed or strongly agreed (score = 5/5 or 4/5), and 25/29 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.862/5.00 for the 29 cadets. The expected level of attainment on this survey is 4.00/5.00.

Level of Achievement of Student Outcome 2:

On completion of the chemical engineering program, our graduates will be able 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.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. End of Semester Student Surveys, once/semester.
3. Course Grades in CH402 Chemical Engineering Process Design, once/yr.
4. Chemical Engineering Program Exit Survey, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

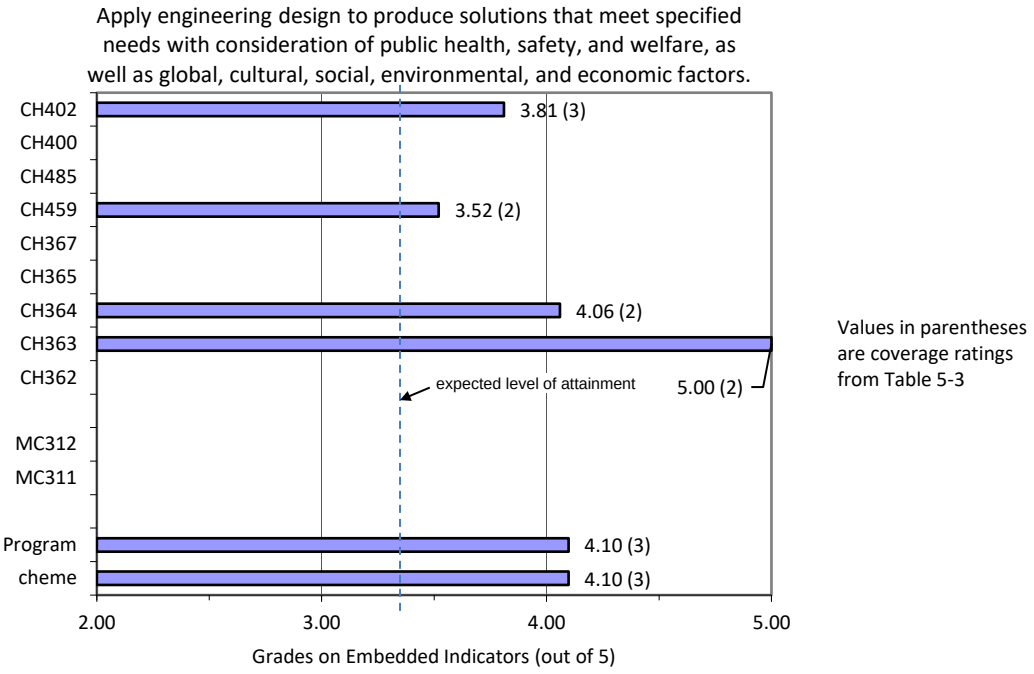

Figure 2-1. Coursework Embedded Indicator results for Student Outcome 2.

2. End of Semester Student Surveys

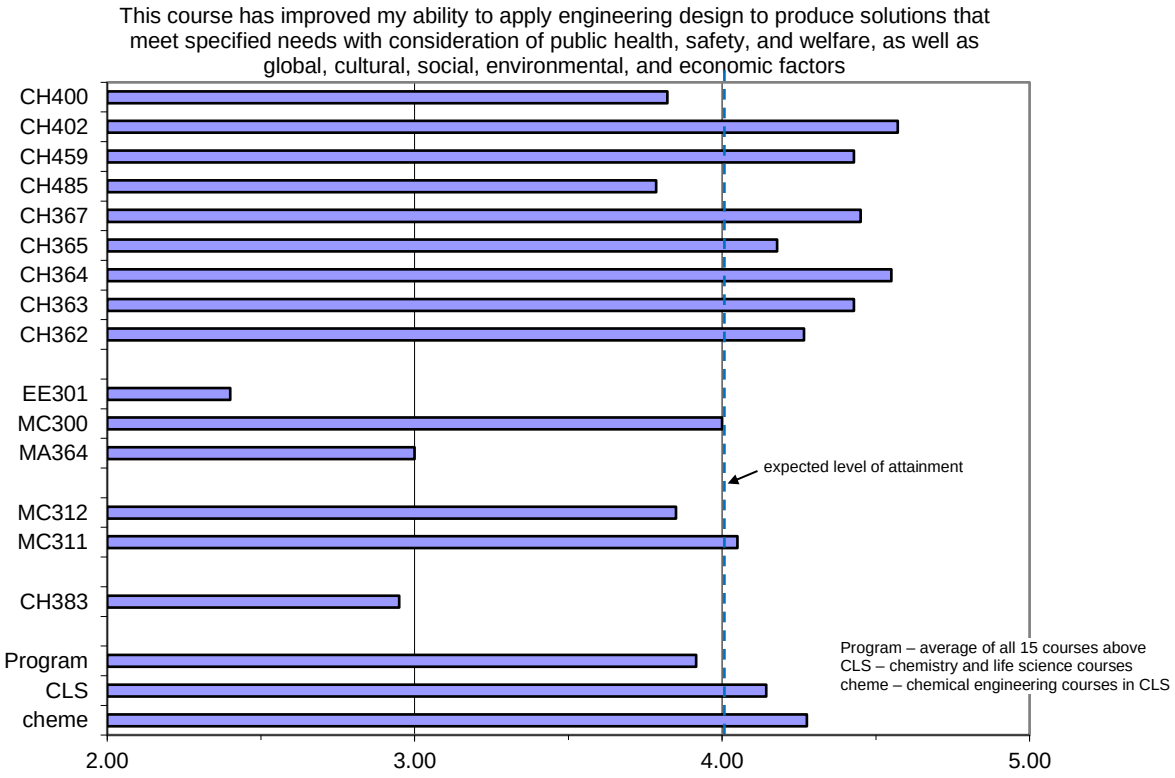

Figure 2-2. End-of-Semester Student Survey responses for Student Outcome 2.

3. The average course grade in CH402 Chemical Engineering Process Design was 3.26±0.70 (n=29) in AY20, compared to 3.27±0.92 (n=21) in AY19, 3.37±0.66 (n=19) in AY18, 2.73±0.39 (n=16) in AY17, 3.43±0.49 (n=24) in AY16, and 3.40±0.75 (n=20) in AY15. *The 5-year running average for the previous five years is 3.24, and this is our expected level of attainment. This year's score was slightly above the 5-year running average.*

4. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement "The program has prepared me 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." 29 out of 29 cadets completed the survey. All 29 cadets said that they either agreed or strongly agreed (score = 5/5 or 4/5), and 20/29 replied that they strongly agreed (score = 5/5). This equates to a mean score of 4.690/5.00 for the 29 cadets. The expected level of attainment on this survey is 4.00/5.00.

Level of Achievement of Student Outcome 3:

On completion of the chemical engineering program, our graduates will be able to communicate effectively with a range of audiences.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. End of Semester Student Surveys, once/semester.
3. Course Grades in CH459 Unit Operations Laboratory, once/yr.
4. Chemical Engineering Program Exit Survey, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

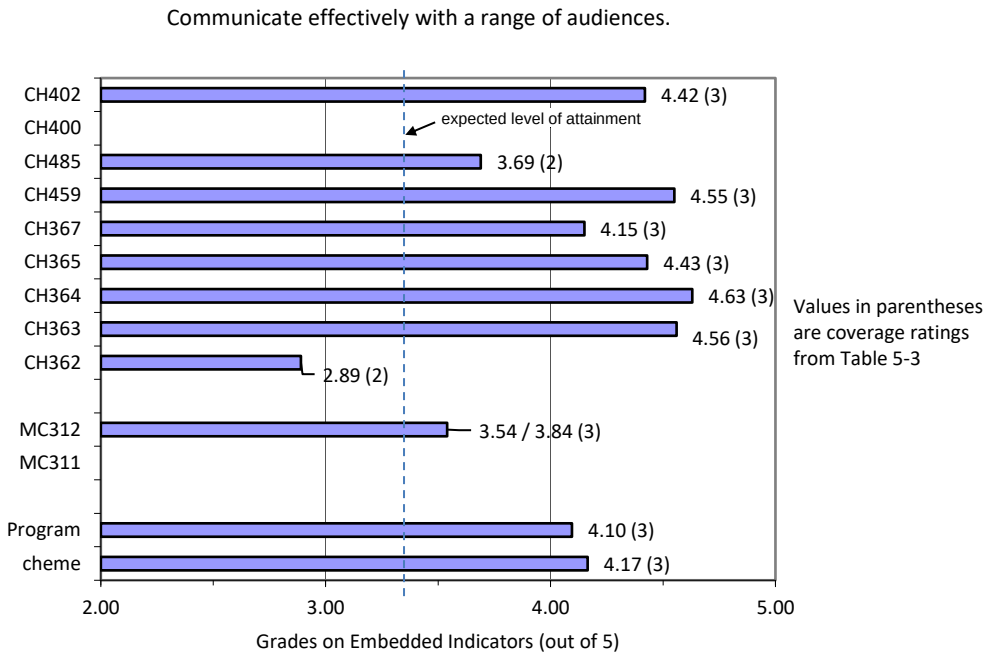

Figure 3-1. Coursework Embedded Indicator results for Student Outcome 3.

2. End of Semester Student Surveys

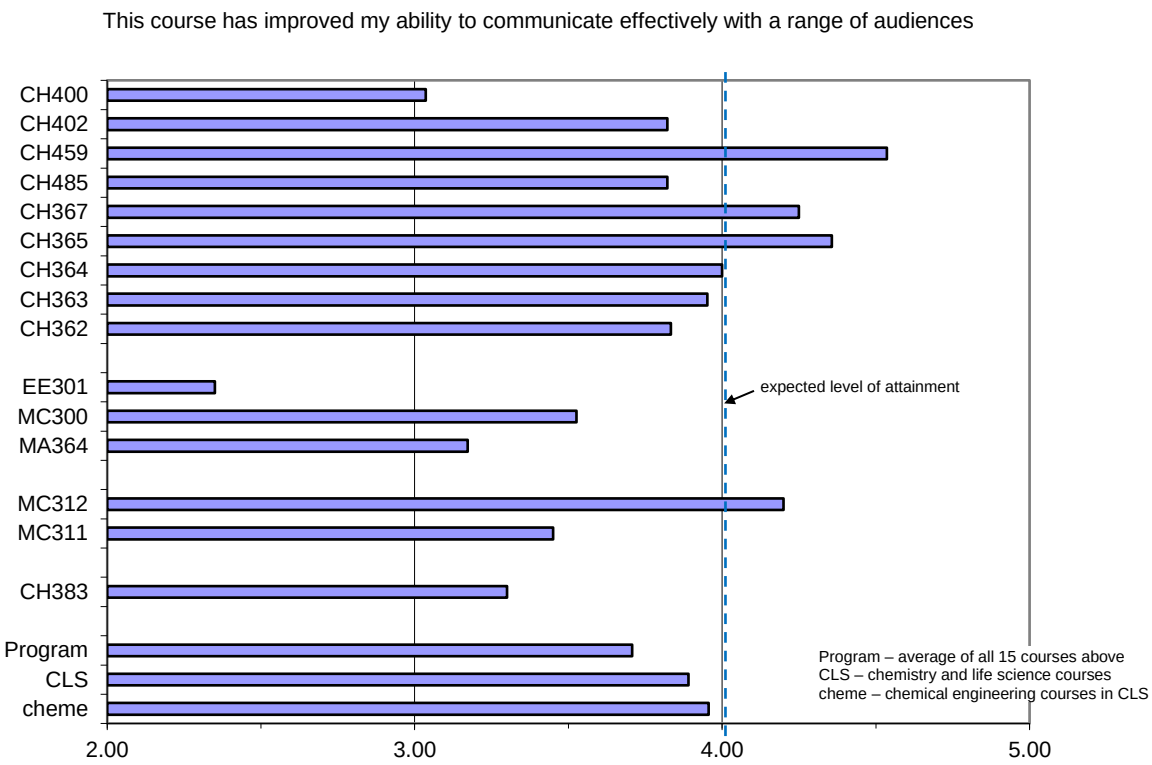

Figure 3-2. End-of-Semester Student Survey responses for Student Outcome 3.

3. The average course grade in CH459 Chemical Engineering Laboratory was 3.53±0.48 (n=29) in AY20, compared to 3.52±0.44 (n=21) in AY19, 3.42±0.64 (n=19) in AY18, 3.54±0.30 (n=16) in AY17, 3.70±0.35 (n=23) in AY16, and 3.67±0.37 (n=20) in AY15. *The 5-year running average is 3.57, and this is our expected level of attainment. This year's score was 0.04 points below the 5-year running average, which is somewhat low but improved over the previous year and well-within the standard deviation.*

4. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether they agree with the statement "The program has prepared me to communicate effectively with a range of audiences." 29 out of 29 cadets completed the survey, with 16/29 replying that they strongly agreed (score = 5/5), 12/29 agreeing (score = 4/5), and 1 cadet was neutral (score = 3/5). This equates to a mean score of 4.517/5.00 for the 29 cadets. The expected level of attainment on this survey is 4.00/5.00.

Level of Achievement of Student Outcome 4:

On completion of the chemical engineering program, our graduates will be able 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.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. Fundamentals of Engineering Examination Performance Index, once/yr.
3. End of Semester Student Surveys, once/semester.
4. Chemical Engineering Program Exit Survey, once/yr.
5. Completion of Cadet Character Education Program, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

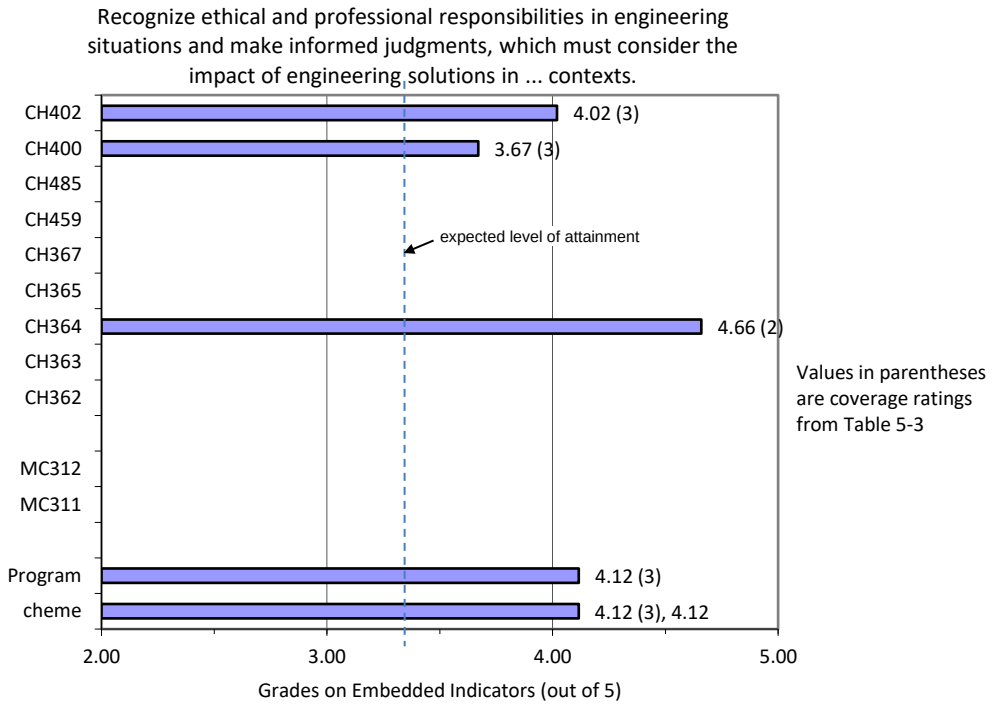

Figure 4-1. Coursework Embedded Indicator results for Student Outcome 4.

2. Fundamentals of Engineering Examination Performance, Self-Study Table 4-2.

Subject	**Outcome**	**Questions**	**USMA**	**National** (expected level of attainment)
Ethics and Professional Practice	4	2	10.0	11.3
Process Design and Economics	4	8	8.5	9.5

The national average performance index was 11.3 ± 5.3 in ethics and professional practice and 9.5 ± 2.6 in process design and economics. Note: the national average is our expected level of attainment, and we are within the standard deviation reported by NCEES.

3. End of Semester Student Surveys

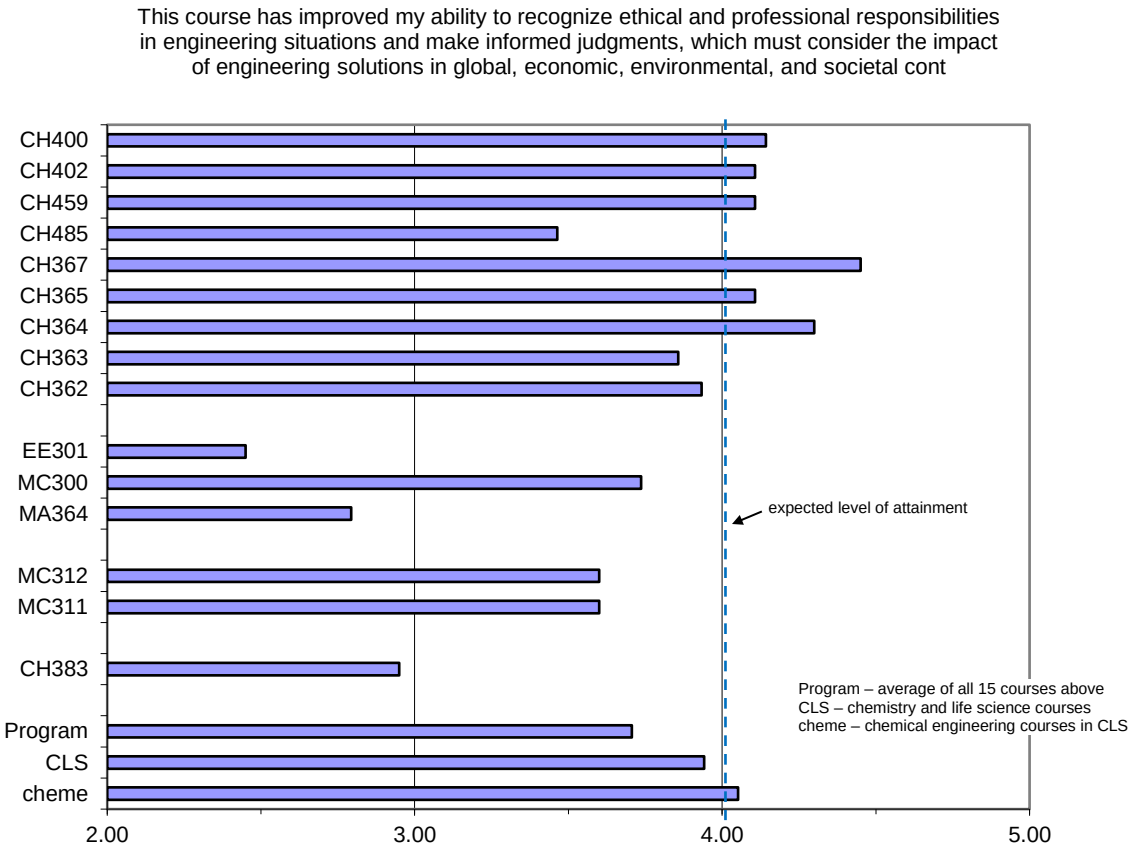

Figure 4-2. End-of-Semester Student Survey responses for Student Outcome 4.

4. Chemical Engineering Program Exit Survey. This survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement "The program has prepared me 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." 29 out of 29 cadets completed the survey, with 15/29 replying that they strongly agreed (score = 5/5), 10/29 agreeing (score = 4/5), and 4 cadets replying that they were neutral (score = 3/5). This equates to a mean score of 4.379/5.00 for the 29 cadets. The expected level of attainment on this survey is 4.00/5.00.

5. Training in honor and ethics takes place in the Cadet Character Education Program (CCEP) during the academic year and summer terms. The program is overseen by the Commandant of Cadets through the Simon Center for the Professional Military Ethic. CCEP customizes instruction to each of the four year-groups of cadets, who interact with faculty volunteers who share their perspectives and experience in the Armed Forces, with industry, and at other civilian institutions. All 29 chemical engineering cadets successfully completed the 4-year CCEP program.

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Level of Achievement of Student Outcome 5:

On completion of the chemical engineering program, our graduates will be able to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. End of Semester Student Surveys, once/semester.
3. Chemical Engineering Program Exit Survey, once/yr.
4. Multidisciplinary Skills Rubric, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

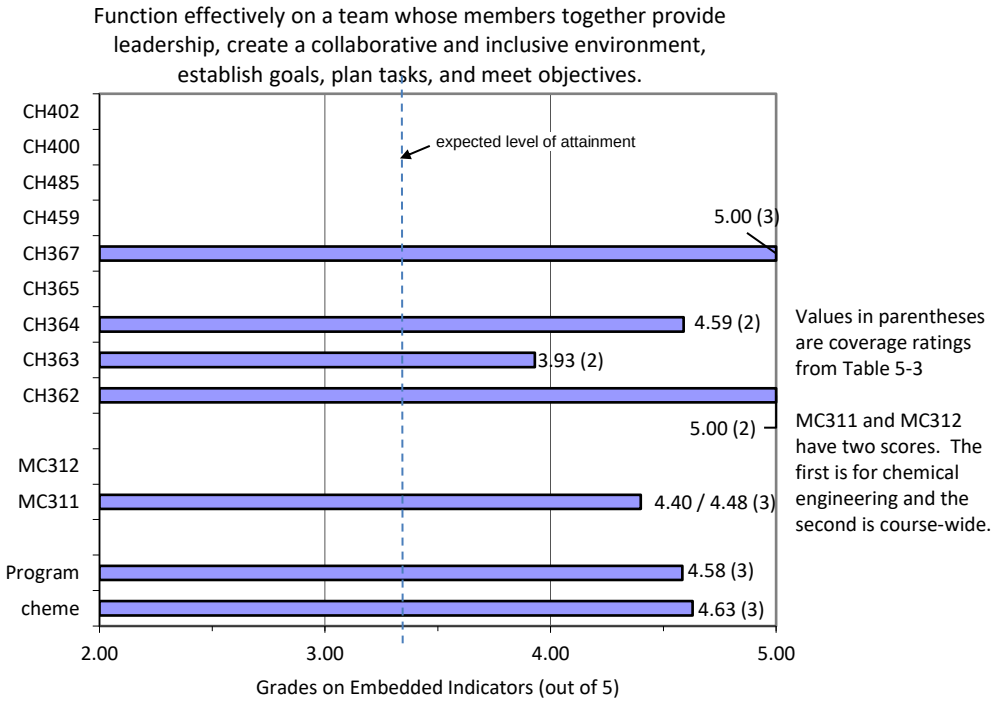

Figure 5-1. Coursework Embedded Indicator results for Student Outcome 5.

2. End of Semester Student Surveys

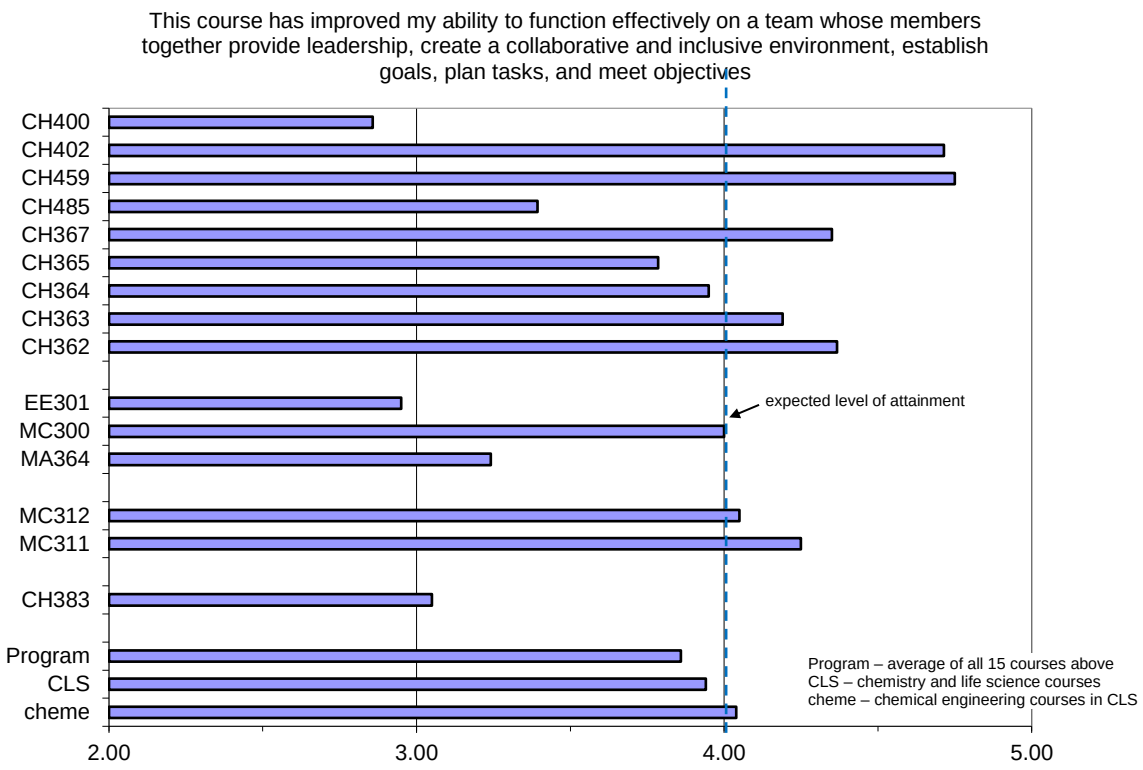

Figure 5-2. End-of-Semester Student Survey responses for Student Outcome 5.

3. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether or not they agree with the statement "The program has prepared me to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives." 29 out of 29 cadets completed the survey, with 23/29 replying that they strongly agreed (score = 5/5), 4/29 agreeing (score = 4/5), and 2 cadets neutral (score = 3/5). This equates to a mean score of 4.724/5.00 for the 24 cadets. The expected level of attainment on this survey is 4.00/5.00.

4. Teamwork Skills Rubric. The rubric is used to assess performance in four skills associated with the ability to function on effectively on a team, namely technical competence, communication, organization, and teamwork. The rubrics are completed by the cadets after each laboratory exercise in CH459. The results were averaged over each round-robin and reported below using the actual rubric for formatting. The superscript "a" next to the averages are for team assessment of the group leader (TAL) and "b" designates group leader assessment of the team (GLAT). The expected level of attainment is 4.0. The color shading indicates the relationship of the averages to the expected level of attainment. Red shading indicates when improvement is needed.

Your Name: Armstrong, LTC; Nagelli, Dr.				Person Assessed: Cadets in CH459					
Your Position: CH459 CD, instructor				Major of Person Assessed: Chemical Engineering					
	1 – Needs Improvement	**1**	**2**	**3 – Meets Expectations**	**3**	**4**	**5 – Exceeds Expectations**	**5**	**N/A**
Technical Competence	**Some misunderstandings of the technical content.**			Demonstrated knowledge of the technical content.			Exceptional knowledge of technical content.	**4.8[a] ±.05[c]** **4.8[b] ±.1[c]**	
Communication	**Lacked sensitivity and/or did not provide specific suggestions for improvement.**			Effectively communicated important points.			Exceptional ability to explain important points. Very effectively communicated ideas for improvement.	**4.8[a] ±.07[c]** **4.8[b] ±.09[c]**	
Organization	**Was not prepared or did not give sufficient time to prepare.**			Demonstrated effective organization during class.			Was exceptionally efficient, timely and responsive throughout the entire process.	**4.7[a] ±.12[c]** **4.9[b] ±.04[c]**	
Teamwork	**Demonstrated limited ability to see other perspectives or find common ground.**			Worked collaboratively with team members to reach consensus.			Exceptional ability to help group find common ground or resolve conflict in order to ultimately reach consensus.	**4.8[a] ±.05[c]** **4.9[b] ±.06[c]**	
Are the cadets capable of functioning on teams? **Yes**	**Comments: Each cadet was group leader twice. Footnote "a" designates the average of all Team Assessments of Leader (TAL) scores, while "b" designates average of all Group Leader Assessment (GLAT) scores. Footnote "c" designates standard deviations.**						Assignment used for assessment: **AY20, Round Robin 1**		

Your Name: Armstrong, LTC; Nagelli, Dr.				Person Assessed: Cadets in CH459					
Your Position: CH459 CD, instructor				Major of Person Assessed: Chemical Engineering					
	1 – Needs Improvement	**1**	**2**	**3 – Meets Expectations**	**3**	**4**	**5 – Exceeds Expectations**	**5**	**N/A**
Technical Competence	**Some misunderstandings of the technical content.**			Demonstrated knowledge of the technical content.			Exceptional knowledge of technical content.	**4.8[a] ±.13[c]** **4.8[b] ±.1[c]**	
Communication	**Lacked sensitivity and/or did not provide specific suggestions for improvement.**			Effectively communicated important points.			Exceptional ability to explain important points. Very effectively communicated ideas for improvement.	**4.7[a] ±.14[c]** **4.9[b] ±.06[c]**	
Organization	**Was not prepared or did not give sufficient time to prepare.**			Demonstrated effective organization during class.			Was exceptionally efficient, timely and responsive throughout the entire process.	**4.7[a] ±.2[c]** **4.8[b] ±.1[c]**	
Teamwork	**Demonstrated limited ability to see other perspectives or find common ground.**			Worked collaboratively with team members to reach consensus.			Exceptional ability to help group find common ground or resolve conflict in order to ultimately reach consensus.	**4.8[a] ±.1[c]** **4.8[b] ±.1[c]**	
Are the cadets capable of functioning on teams? **Yes**	**Comments: Each cadet was group leader twice. Footnote "a" designates the average of all Team Assessments on Leader (TAL) scores, while "b" designates average of all Group Leader Assessment (GLAT) scores. Footnote "c" designates standard deviations.**						Assignment used for assessment: **AY20, Round Robin 2**		

Level of Achievement of Student Outcome 6:

On completion of the chemical engineering program, our graduates will be able to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. End-of-Semester Student Surveys, once/semester.
3. Chemical Engineering Program Exit Survey, once/yr.
4. Course Grades in CH459 Unit Operations Laboratory, once/yr.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

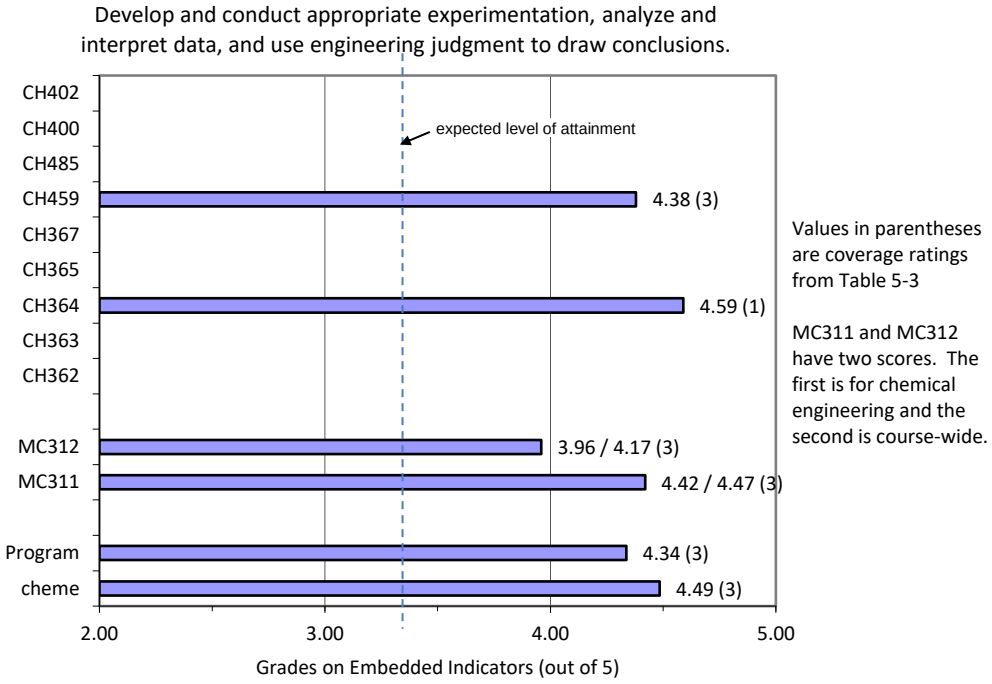

Figure 6-1. Coursework Embedded Indicator results for Student Outcome 6.

2. End of Semester Student Surveys

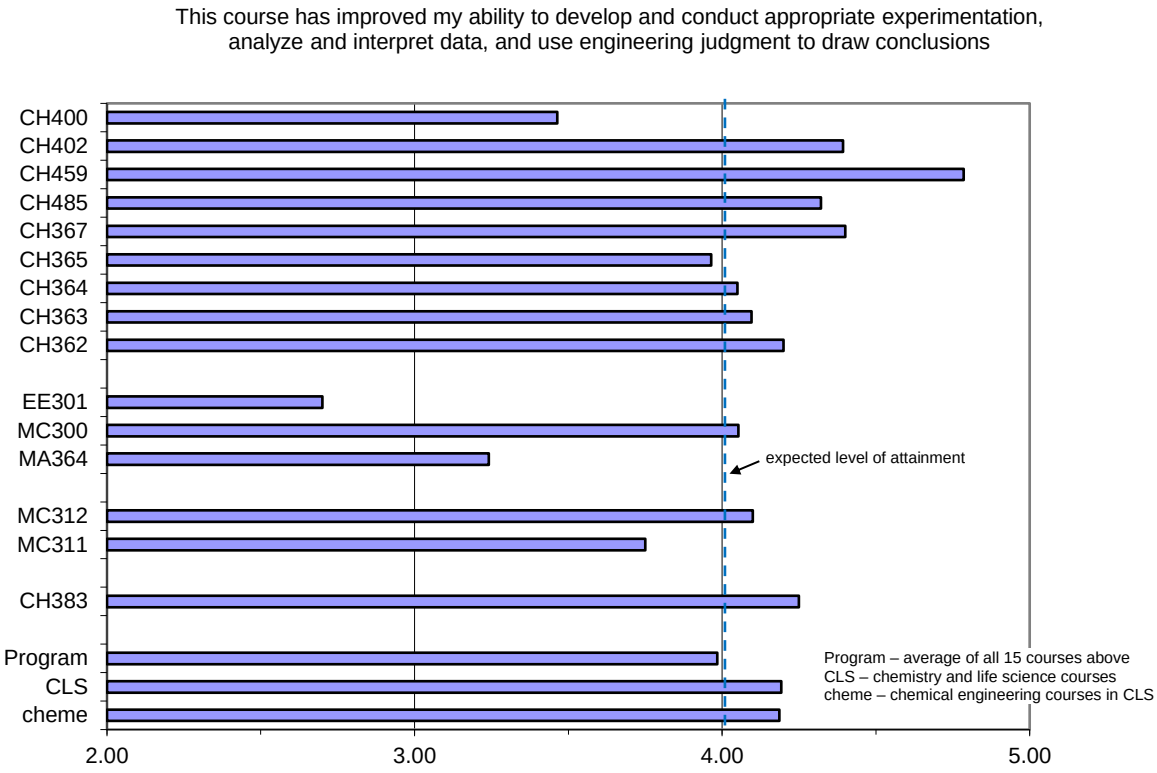

Figure 6-2. End-of-Semester Student Survey responses for Student Outcome 6.

3. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether they agree with the statement "The program has prepared me to Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions." 29 out of 29 cadets completed the survey, with 18/29 replying that they strongly agreed (score = 5/5), 10/29 agreeing (score = 4/5), and 1 cadet was neutral (score = 3/5). This equates to a mean score of 4.586/5.00 for the 29 cadets. The expected level of attainment on this survey is 4.00/5.00.

4. The average course grade in CH459 Chemical Engineering Laboratory was 3.53±0.48 (n=29) in AY20, compared to 3.52±0.44 (n=21) in AY19, 3.42±0.64 (n=19) in AY18, 3.54±0.30 (n=16) in AY17, 3.70±0.35 (n=23) in AY16, and 3.67±0.37 (n=20) in AY15. *The 5-year running average is 3.57, and this is our expected level of attainment. This year's score was 0.04 points below the 5-year running average, which is low but improved over the previous year, and well-within the standard deviation.*

Level of Achievement of Student Outcome 7:

On completion of the chemical engineering program, our graduates will be able to acquire and apply new knowledge as needed, using appropriate learning strategies.

Assessment Instruments and Frequency:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators, once/yr.
2. Percent of eligible students taking the Fundamentals of Engineering Examination (FEE), once/yr.
3. End of Semester Student Surveys, once/semester.
4. Chemical Engineering Program Exit Survey, once/yr.
5. Lifelong Learning Skills Rubric, twice per year.
6. Contemporary Issues Rubric, multiple times per year.

Assessment Results:

1. Chemical & Mechanical Engineering Coursework Embedded Indicators

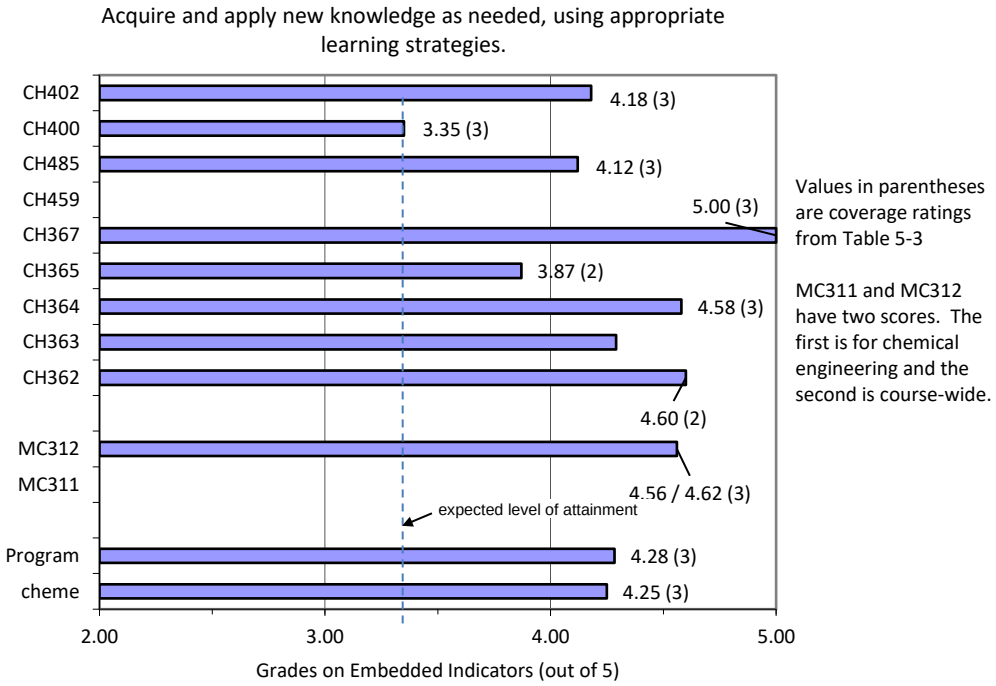

Figure 7-1. Coursework Embedded Indicator results for Student Outcome 7.

2. Percent of Eligible Cadets taking the Fundamentals of Engineering Examination (FEE). For the Class of 2020, 9 of 29 chemical engineering cadets (31% of eligible cadets) prepared for and took the FEE. This compares to 100% from 2015 to 2019. This decline was due to closure of NCEES test centers nationwide during the COVID-19 crisis. NCEES reported a decline from 1047 in 2019 to 480 in 2020 for the period 1 January through 30 June 2020. Note: Given the circumstances, the participation rate should be considered GOOD.

3. End of Semester Student Surveys

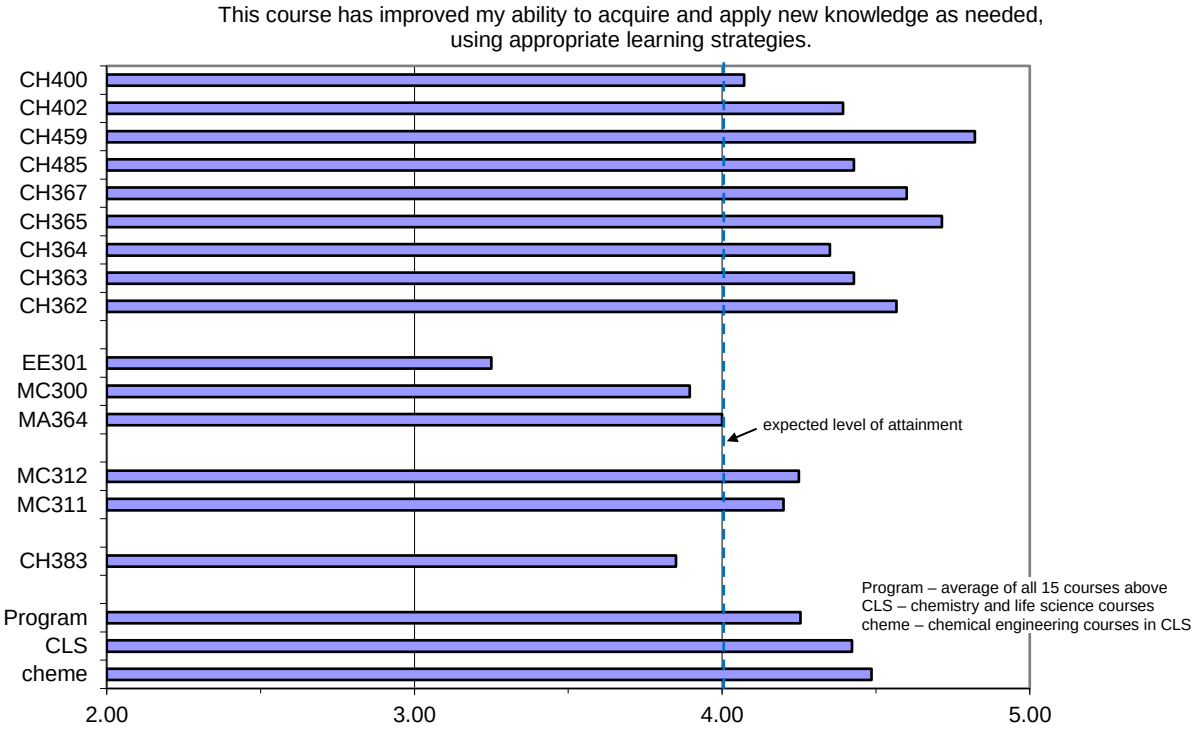

Figure 7-2. End-of-Semester Student Survey responses for Student Outcome 7.

4. Chemical Engineering Program Exit Survey. As stated earlier, this survey is given to the firsties at the end of their last semester. In this question, they were asked whether they agree with the statement "The program has prepared me to Acquire and apply new knowledge as needed, using appropriate learning strategies." 29 out of 29 cadets completed the survey, with 23/29 replying that they strongly agreed (score = 5/5), 5/29 agreeing (score = 4/5), and 1 cadet was neutral (score = 3/5). This equates to a mean score of 4.759/5.00 for the 29 cadets. The expected level of attainment is 4.00/5.00.

5. Lifelong Learning Skills Rubric. This rubric, when used in tandem with the resume writing assignment in CH365, is designed to assess performance in four skills associated with the ability to acquire new knowledge, namely: rubric row 1 - engagement (in professional activities), rubric row 2 - recognition (of skills learned in the program), rubric row 3 – intellectual growth (recognition of new skills), and rubric row 4 – communication (in resume format). Resumes were written at the beginning of the semester (assignment 1.1), revised (assignment 1.2), then revised again at the end of the semester (assignment 2.0). One rubric is shown for each assignment below, along with cadet averages and standard deviations. The expected levels of attainment are color-coded, with red indicating a need for

improvement, yellow indicating acceptable performance, and green indicating that expectations are met or exceeded. Instructor comments are in the rubrics.

Instructor's Name: **Professor Biaglow**				Cadet Assessed: **All Cadets in CH365**				
Your Position: **CD, CH365** (e.g., CD CH365)				Cadet Major: **Chemical Engineering** (e.g., Chem. Eng.)				
	1 – Needs Improvement	**1**	**2**	**3 – Meets Expectations**	**3**	**4**	**5 – Exceeds Expectations**	**5**
Engagement Outcome 7	No evidence of pre-professional activities.			References to pre-professional activities are lacking or connections to chemical engineering are weak or implied.	2.6 +/- 1.1		Uses examples of pre-professional chemical engineering activities.	
Recognition Outcome 7	Skills learned in chemical engineering courses taken in previous semesters are not listed.		2.6 +/- 1.0	Skills are listed, but the skills are vaguely described, or connection to chemical engineering concepts is not clear.			Identifies specific skills learned in chemical engineering courses.	
Intellectual Growth Outcome 7	Unable to identify new concepts learned this semester.	1.4 +/- 1.0		Changes are apparent in document, but connections to recent activities in chemical engineering are weak or implied.			Addition of multiple skills acquired this semester.	
Communication Outcome 3	Resume lacks organization or cohesion. Numerous grammatical errors that may interfere with meaning. Target audience unclear.			Occasional grammar errors that do not impede meaning. Demonstrates ability to write a basic resume, but document is uninteresting and flat.	3.2 +/- 1.4		Demonstrates an ability to effectively communicate in the resume format. Clear, concise content. Resume is interesting.	
Has this cadet demonstrated SO7 (acquiring knowledge)? **(Y/N)** No	Comments: **Cadets struggle with this assignment. Many have not written a resume before. Some have written CVs for the scholarship course but that is different from a resume. Significant feedback was provided to cadets.** Final Grade: 2.4+/-1.3 / 5.0						Assignment used for assessment: (e.g., resume draft 1.1 in CH365) **Resume Draft 1.1 in CH365**	

Instructor's Name: **Professor Biaglow**				Cadet Assessed: **All Cadets in CH365**				
Your Position: **CD, CH365** (e.g., CD CH365)				Cadet Major: **Chemical Engineering** (e.g., Chem. Eng.)				
	1 – Needs Improvement	**1**	**2**	**3 – Meets Expectations**	**3**	**4**	**5 – Exceeds Expectations**	**5**
Engagement Outcome 7	No evidence of pre-professional activities.			References to pre-professional activities are lacking or connections to chemical engineering are weak or implied.			Uses examples of pre-professional chemical engineering activities.	4.8 +/- 0.4
Recognition Outcome 7	Skills learned in chemical engineering courses taken in previous semesters are not listed.			Skills are listed, but the skills are vaguely described, or connection to chemical engineering concepts is not clear.		4.0 +/- 1.1	Identifies specific skills learned in chemical engineering courses.	
Intellectual Growth Outcome 7	Unable to identify new concepts learned this semester.			Changes are apparent in document, but connections to recent activities in chemical engineering are weak or implied.	3.3 +/- 1.4		Addition of multiple skills acquired this semester.	
Communication Outcome 3	Resume lacks organization or cohesion. Numerous grammatical errors that may interfere with meaning. Target audience unclear.			Occasional grammar errors that do not impede meaning. Demonstrates ability to write a basic resume, but document is uninteresting and flat.		3.8 +/- 0.7	Demonstrates an ability to effectively communicate in the resume format. Clear, concise content. Resume is interesting.	
Has this cadet demonstrated SO7 (acquiring knowledge)? **(Y/N)** Yes	Comments: **Generally cadet scores improved after incorporation of instructor feedback from Draft 1.1.** Final Grade: 4.0+/-1.1 / 5.0						Assignment used for assessment: (e.g., resume draft 1.1 in CH365) **Resume Draft 1.2 in CH365**	

Instructor's Name:	Professor Biaglow			Cadet Assessed:	All Cadets in CH365				
Your Position:	CD, CH365 (e.g., CD CH365)			Cadet Major:	Chemical Engineering (e.g., Chem. Eng.)				
	1 – Needs Improvement	1	2	3 – Meets Expectations	3	4	5 – Exceeds Expectations	5	
Engagement Outcome 7	No evidence of pre-professional activities.			References to pre-professional activities are lacking or connections to chemical engineering are weak or implied.			Uses examples of pre-professional chemical engineering activities.	5.0 +/- 0.2	
Recognition Outcome 7	Skills learned in chemical engineering courses taken in previous semesters are not listed.			Skills are listed, but the skills are vaguely described, or connection to chemical engineering concepts is not clear.			Identifies specific skills learned in chemical engineering courses.	4.8 +/- 0.4	
Intellectual Growth Outcome 7	Unable to identify new concepts learned this semester.			Changes are apparent in document, but connections to recent activities in chemical engineering are weak or implied.		4.1 +/- 0.5	Addition of multiple skills acquired this semester.		
Communication Outcome 3	Resume lacks organization or cohesion. Numerous grammatical errors that may interfere with meaning. Target audience unclear.			Occasional grammar errors that do not impede meaning. Demonstrates ability to write a basic resume, but document is uninteresting and flat.			Demonstrates an ability to effectively communicate in the resume format. Clear, concise content. Resume is interesting.	4.8 +/- 0.4	
Has this cadet demonstrated SO7 (acquiring knowledge)? (Y/N) Yes	Comments: In general, cadets got the hang of this exercise and were able to demonstrate intellectual growth by revising their resumes at the end of the semester. Final Grade: 4.6+/-0.5 / 5.0						Assignment used for assessment: (e.g., resume draft 1.1 in CH365) Resume Draft 2.0 in CH365		

Interestingly but not unexpected, there is significant improvement in scores between versions 1.1 and 1.2 as cadets incorporated instructor comments to improve and polish their documents. Version 2.0 is different, though, in that it is not just more of the same. This resume is submitted at the end of the semester. To obtain high scores, cadets had to have made significant modifications to the resumes from the beginning of the semester. Scores can go down if cadets do not show new activities and skills, and some individual cases the scores did drop. However, overall and on average, the program scores are solidly in the green in all four categories by the end of the semester.

6. Contemporary Issues Rubric.

Instructor's Name: **LTC Miller**				Cadet Assessed: **All Cadets in CH485**				
Your Position: **CD, CH485** (e.g., CD CH485)				Cadet Major: **Chemical Engineering** (e.g., Chem. Eng.)				
	1 – Needs Improvement	**1**	**2**	**3 – Meets Expectations**	**3**	**4**	**5 – Exceeds Expectations**	**5**
Acquiring Knowledge Outcome 7	Cites references but they are not substantive or do not address assignment. Context is weak or implied. Uses generic arguments or lacks specificity.			Cites at least two references relevant to the assignment. References have been adequately studied and re-worded to support a thesis.		4.2 +/- 1.3	Uses multiple substantive examples or scholarly articles in an integrative fashion to support a thesis.	
Technical Competence Outcomes 8	Demonstrates poor or incomplete understanding of technical content.			Demonstrates some knowledge of the technical content, but explanation lacks adequate depth.	3.5 +/- 1.1		Demonstrates exceptional knowledge of technical content.	
Synthesis of Ideas Outcome 3	Does not have a premise or does not connect issues in essay to concepts in chemical engineering.			Makes connections to chemical engineering concepts, but the connections are weak or implied or premise is weak.	3.2 +/- 1.4		Makes very clear connections between premise and chemical engineering concepts.	
Grammar and Structure Outcome 3	Lacks organization or cohesion. Numerous grammatical errors or errors interfere with meaning. Thesis lacking or implied.			Occasional grammar that do not impede meaning. Demonstrates ability to write an essay but lacks cohesion or completeness. Thesis not fully supported.	3.2 +/- 1.3		Demonstrates an ability to effectively communicate in the essay format. Fully supported, clear, concise thesis. Writing style was exceptionally clear and articulate.	
Has this cadet demonstrated SO7 (acquiring knowledge)? **(Y/N)** Y	Comments: **Cadets were able to acquire new knowledge. They identified a subject in medicine that included mass and/or heat transfer. Cadets tended to discuss points as if following a checklist without connecting topics to an overall premise. A few were incomplete.** Final Grade: **3.5 +/- 1.3**						Assignment used for assessment: (e.g., draft 1 writing assignment 1 in CH485) **CH485 Writing Draft 1**	

Instructor's Name: **LTC Miller**				Cadet Assessed: **All Cadets in CH485**				
Your Position: **CD, CH485** (e.g., CD CH485)				Cadet Major: **Chemical Engineering** (e.g., Chem. Eng.)				
	1 – Needs Improvement	**1**	**2**	**3 – Meets Expectations**	**3**	**4**	**5 – Exceeds Expectations**	**5**
Acquiring Knowledge Outcome 7	Cites references but they are not substantive or do not address assignment. Context is weak or implied. Uses generic arguments or lacks specificity.			Cites at least two references relevant to the assignment. References have been adequately studied and re-worded to support a thesis.			Uses multiple substantive examples or scholarly articles in an integrative fashion to support a thesis.	4.8 +/- 0.9
Technical Competence Outcomes 8	Demonstrates poor or incomplete understanding of technical content.			Demonstrates some knowledge of the technical content, but explanation lacks adequate depth.		4.4 +/- 1.1	Demonstrates exceptional knowledge of technical content.	
Synthesis of Ideas Outcome 3	Does not have a premise or does not connect issues in essay to concepts in chemical engineering.			Makes connections to chemical engineering concepts, but the connections are weak or implied or premise is weak.		4.3 +/- 1.1	Makes very clear connections between premise and chemical engineering concepts.	
Grammar and Structure Outcome 3	Lacks organization or cohesion. Numerous grammatical errors or errors interfere with meaning. Thesis lacking or implied.			Occasional grammar that do not impede meaning. Demonstrates ability to write an essay but lacks cohesion or completeness. Thesis not fully supported.		4.1 +/- 1.1	Demonstrates an ability to effectively communicate in the essay format. Fully supported, clear, concise thesis. Writing style was exceptionally clear and articulate.	
Has this cadet demonstrated SO7 (acquiring knowledge)? **(Y/N)** Y	Comments: **Cadets improved significantly, the majority clearly stated a premise and included additional technical knowledge. All Cadets displayed that they acquired new knowledge. Cadets still can work on connecting the details and technical aspect to the premise.** Final Grade: **4.4 +/- 1.0**						Assignment used for assessment: (e.g., draft 1 writing assignment 1 in CH485) **CH485 Writing Draft 2**	

The contemporary issues rubric is designed to assess performance in four skills associated with the ability to acquire new knowledge, namely: rubric row 1 - acquiring knowledge (through development and use of references), rubric row 2 - technical competence of the cadet (as demonstrated with writing skills), rubric row 3 - synthesis of ideas (into a coherent essay), and rubric row 4 - grammar and structure. Each of these skills, taken independently, are associated with written communication (Student Outcome 3). However, the development and blending of these skills into a coherent and well-crafted essay are a measure of acquisition of new knowledge and are thus used by our program to assess Student Outcome 8. Admittedly, this is not a complete measure of a student's ability to acquire new knowledge, only that ability as expressed in an essay. The program therefore combines this exercise with the other embedded indicators in this section of the report.

Operationally, the contemporary issues rubric is completed by the instructor to award grades to cadets for specific assignments in his or her course. In this case, LTC Miller used two writing assignments in CH485. The first assignment was a first draft, and the second was the second (final) draft for her assignment. The results are summarized on the previous page from the averages and standard deviations for the 29 cadets enrolled in CH485, using the actual rubric to format the results. The cadet average scores are shown for each rubric item. The expected levels of attainment are color-coded red (indicating a need for improvement), yellow (minimal level of performance), and green (expectations are exceeded). In this case, on average, the cadets apparently exceeded program expectations in both cases.

Level of Achievement of Student Outcome 8:

The program provides the graduate with a thorough grounding and working knowledge of the chemical sciences, including:

- (8.1) Chemistry.
- (8.2) Material and energy balances
- (8.3) Safety and environmental factors.
- (8.4) Thermodynamics of physical and chemical equilibria.
- (8.5) Heat, mass, and momentum transfer.
- (8.6) Chemical reaction engineering.
- (8.7) Continuous and staged separation operations.
- (8.8) Process dynamics and control.
- (8.9) Modern experimental and computing techniques.
- (8.10) Process design.

Assessment Instruments and Frequency:

1. Fundamentals of Engineering Examination, once/yr.
2. Average Course Grades for Chemical Engineering Students, once/yr.

Assessment Results:

1. Fundamentals of Engineering Examination, Table 4-14. For the Class of 2018, the breakdown by topic is shown in comparison to the national averages.

Subject	**Outcome**	**Questions**	**USMA ChE**	**National** (expected level of attainment)
Chemistry	8.1	8	9.1	9.9
Material & Energy Balances	8.2	8	8.6	9.6
Safety, Health, & Environmental	8.3	5	7.2	9.5
Thermodynamics	8.4	8	8.1	9.3
Heat Transfer	8.5	8	8.9	9.9
Fluid Mechanics/Dynamics	8.5	8	9.4	9.6
Chemical Reaction Engineering	8.6	8	9.3	9.6
Mass Transfer & Separations	8.7	8	8.7	9.6
Process Control	8.8	5	8.6	9.7
Computational Tools	8.9	4	10.5	10.4
Process Design & Economics	8.10	8	8.5	9.5

2. Course grades for the last six years are shown below, Table 4-2.

		Chemical Engineering Student Outcome 8								
↓ Course		Advanced Chemistry	Mater. & Energy Bal.	Thermodynamics	Transport	Reaction Engineering	Separations	Dynamics & Control	Experiment & Compute	Process Design
		8.1	**8.2**	**8.4**	**8.5**	**8.6**	**8.7**	**8.8**	**8.9**	**8.10**
CH383	Organic Chemistry I	3.06								
CH365	Chem. Eng. Thermo.			3.53						
CH362	Mass & Energy Balances		3.53							
CH363	Separation Processes						3.64			
CH364	Chem. Reaction Eng.					3.38				
CH459	Chem. Eng. Laboratory								3.53	
CH485	Heat and Mass Transfer				3.30					
CH400	Chemical Engineering Sem.									
CH402	Chem. Eng. Process Des.									3.26
MA366	Vector Calculus									
ME311	Thermal-Fluid Systems I			3.24	3.24					
ME312	Thermal-Fluid Systems II			3.05	3.05					
CE300	Fund. Eng. Mech. & Des.									
EE301	Intro. To Elec. Engineering									
CH367	Intro. Auto. Process Control							3.36		
Average Grade 2020		3.06	3.53	3.27	3.20	3.38	3.64	3.36	3.53	3.26
Average Grade 2019		3.14	3.63	3.69	3.39	3.67	3.92	3.51	3.52	3.27
Average Grade 2018		2.87	3.72	3.51	3.20	3.66	3.67	3.53	3.42	3.37
Average Grade 2017		3.15	3.21	3.65	3.25	3.66	3.67	3.31	3.54	2.73
Average Grade 2016		3.19	3.57	3.43	3.32	3.64	3.57	3.55	3.70	3.43
Average Grade 2015		3.33	3.63	3.43	3.33	3.72	3.71	3.60	3.67	3.4
Previous 5-year Running Average *(expected level of attainment)*		*3.14*	*3.55*	*3.54*	*3.30*	*3.67*	*3.71*	*3.50*	*3.57*	*3.24*
Standard Deviation 2020		0.68	0.40	0.66	0.69	0.67	0.69	0.69	0.48	0.63

Table 4-3. Faculty Evaluation of Chemical Engineering Student Outcomes

Chemical Engineering Student Outcomes	**Faculty Evaluation**
On completion of the chemical engineering program, our graduates are able to:	
1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	4.88 ± 0.35
2. 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.	4.38 ± 0.74
3. Communicate effectively with a range of audiences.	3.75 ± 1.16
4. 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.	4.25 ± 0.46
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	4.75 ± 0.71
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	4.50 ± 0.53
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.	4.50 ± 0.76
8. Understand the chemical engineering curriculum, including chemistry, material and energy balances, safety and environmental factors, thermodynamics of physical and chemical equilibria, heat, mass, and momentum transfer, chemical reaction engineering, continuous and staged separation processes, process dynamics and control, modern experimental and computing techniques, and process design.	4.75 ± 0.46
5- Excellent; **4** – Very Good; **3** – Acceptable; **2** – Weak ; **1** – Poor	

Table 4-4. Advisory Board Evaluation of Chemical Engineering Student Outcomes

Chemical Engineering Student Outcomes	**Advisory Board's Evaluation**
On completion of the chemical engineering program, our graduates are able to:	
1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	n/a
2. 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.	n/a
3. Communicate effectively with a range of audiences.	n/a
4. 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.	n/a
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	n/a
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	n/a
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.	n/a
8. Understand the chemical engineering curriculum, including chemistry, material and energy balances, safety and environmental factors, thermodynamics of physical and chemical equilibria, heat, mass, and momentum transfer, chemical reaction engineering, continuous and staged separation processes, process dynamics and control, modern experimental and computing techniques, and process design.	n/a
5- Excellent; **4** – Very Good; **3** – Acceptable; **2** – Weak ; **1** – Poor	

Note: These entries are n/a because advisory board data will be available after the meeting currently scheduled for 23 April 2021.

Table 4-5. Summary of Chemical Engineering Student Outcomes Performance.

Chemical Engineering Student Outcomes	**Program Director's Summary**
On completion of the chemical engineering program, our graduates are able to:	
1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	5
2. 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.	5
3. Communicate effectively with a range of audiences.	4
4. 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
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	5
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	5
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.	5
8. Understand the chemical engineering curriculum, including chemistry, material and energy balances, safety and environmental factors, thermodynamics of physical and chemical equilibria, heat, mass, and momentum transfer, chemical reaction engineering, continuous and staged separation processes, process dynamics and control, modern experimental and computing techniques, and process design.	5
5- Excellent; **4** – Very Good; **3** – Acceptable; **2** – Weak ; **1** – Poor	

These PD entries are preliminary estimates only as of October 6, 2020.

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Chem E. Exec. Summary

1. No meeting this year; and no scheduled virtual meeting. However, we can meet one on one via Teams Call, etc. to discuss and answer questions.

2. During our ABET reaccreditation visit there were no short comings and a strength was our use of the SSI simulation software. These findings are confidential and should be kept internal to the board; the findings will be finalized when the Commissions meet in July.

3. We are adding two courses: 1. CH300 introduction to biomedical engineering; and 2. CH350 introduction to bio engineering during AY22.

4. We had an 80% FEE pass rate for Class of 2020; but only 10 cadets were able to take FEE due to Covid.

5. We have 29 new chemical engineers in Class of 2024.

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Chemical Engineering

Advisory Board Meeting

23 April 2021

United States Military Academy
Department of Chemistry and Life Science

Meeting Endstate

1. 100% surveys complete

2. Discussions with chemical engineering faculty and cadets complete

3. Tours of chemical engineering lab, work, classroom space complete

3. Travel paperwork complete

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Lunch – Subs and Wraps

Lunch:

1. Cold cut Italian mix sandwiches and wraps
2. Mixed salad
3. Chips: regular/barbeque/sour cream & onion/Cheetos/Doritos
4. Iced tea/soda/water/coffee
5. **Cookie plate**

Chemical Engineering

Advisory Board Meeting

23 April 2021

1. Introductory Remarks

United States Military Academy
Department of Chemistry and Life Science

Thank you!

- For the opportunity to show you America's Military Academy
- For your service and insights to help our program improve
- For the time you have dedicated to this visit
- For your dedication to the profession

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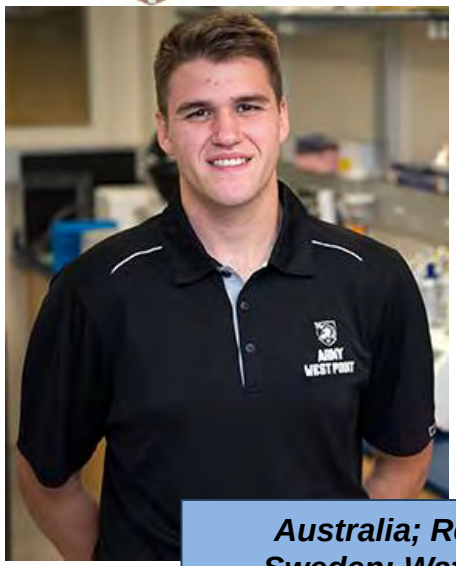
CDT Jesse Palmer, ’19
Chemical Engineering



- **Won Stamps Scholarship**
- **Won Goldwater Scholarship**
- **Tau Beta Pi Honor Society**
- **Phi Kappa Phi Honor Society**
- **Phi Sigma Iota Society**
- **Won Churchill Scholarship**

Co-Authored Publications

1. Cellulose Nanofiber Biotemplated Palladium Composite Aerogels. *Molecules,* 23(6)
2. Gelatin biotemplated platinum aerogels. *MRS Advances*, 1-6.
3. A Rapid Synthesis Method for Au, Pd, Aerogels Via direct Solution-Based Reduction. *Journal of visualized experiments: JoVE*, (136).
4. Direct solution-based reduction synthesis of Au, Pd, and Pt Aerogels. *Journal of Materials Research*, 32(22).

Australia; Renewable Energy Lab
Sweden: Water NEXUS conference

Harvard AIAD; Disease biophysics groups

Fourth Class → **Third Class** → **Second Class** → **First Class** → **Beyond**

CH290 → **CH389/CH390** → **CH489/CH490**

USMA Independent Research

Jesse has collaborated with the Army Research Labs (ARL) in Adelphi, MD to produce biosensors and has developed novel Kevlar-cellulose composites with Harvard’s Disease Biophysics group. As a recipient of Goldwater and Stamps Scholarships Jesse has used his academic funding to attend World Water Week in Stockholm, Sweden and visit the University of New South Wales in Sydney, Australia to pursue his interest in water desalination. Jesse is also completing a minor in Eurasian Studies. He plans on attending graduate school to develop batteries to enhance prosthetic limbs serving wounded veterans.

Field Artillery Officer

Future Faculty

USMA MISSION

To *educate, train, and inspire*

the Corps of Cadets so that each graduate

is a commissioned *leader of character*

committed to the values of

Duty, Honor, Country

and prepared for a career of professional

excellence and service to the Nation as

an officer in the United States Army.

USMA Vision

Within an Army in transition,

West Point is the preeminent leader development and academic institution whose graduates thrive in tomorrow's complex security environments,

and are inspired to a lifetime of service to our Army and the Nation as leaders of character.

West Point is the preeminent leader development institution in the world.

Program Vision

We envision an Army that is prepared for all dimensions of modern warfare, drawing upon disciplined, highly trained chemical engineers to develop solutions to the challenges facing the nation.

Program Mission

The mission of the chemical engineering program is to prepare commissioned leaders of character who are proficient in applying chemical and engineering principles to solve problems in a complex operational environment.

ABET | Engineering Technology Accreditation Commission

Accredited **1 October 2012** to present

Next Record Year: **AY2025-2026**

ABET Visit: **Early September 2026**

Why ABET Accreditation?

- An external certification of quality
- Keeps us in touch with the engineering profession
- Helps USMA (and ChemE) recruiting (2020 – 29; 2021 - 20; 2022 - 29; 2023 -…*so far 12*)
- Provides important opportunities for graduates
- Allows USMA engineering majors to take the Fundamentals of Engineering Examination
- It is required by Army Regulations (10-87).
- Almost everything that ABET expects us to do is something we should be doing anyway.

Thoughts to Consider

- The ABET process is expensive in terms of faculty time
  - USMA is a small undergraduate college with limited human resources (faculty) and high faculty turnover
- The ABET accreditation is important to the institution and to the Army (so we tend to do it well)
- The only way we can be successful with ABET is to orient our program processes around the ABET criteria
  - By doubling up our efforts we obtain some efficiency
  - Much of what follows is oriented around the ABET processes and terminology
  - We need to be strategic in deciding on new initiatives

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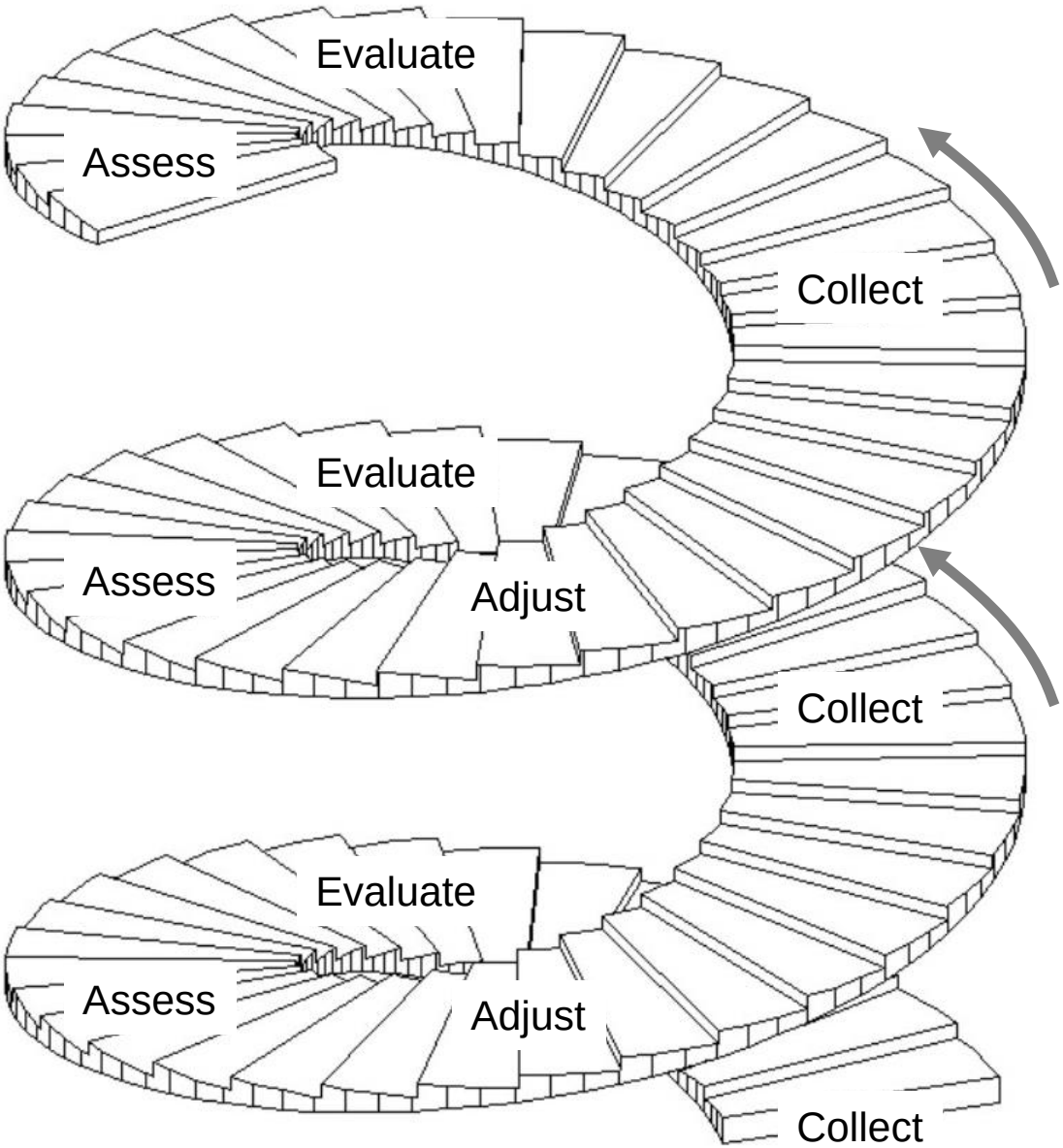
Terms You Should Know

- **Program Educational Objectives (PEOs)**
  - Gleaned by asking *program constituents*
    - For us: Army, profession, graduate schools, other
  - **Our external *Advisory Board* a key resource**
  - Desired professional accomplishments of graduates **5-7 years after graduation**
  - Adjust every 3 years or so…

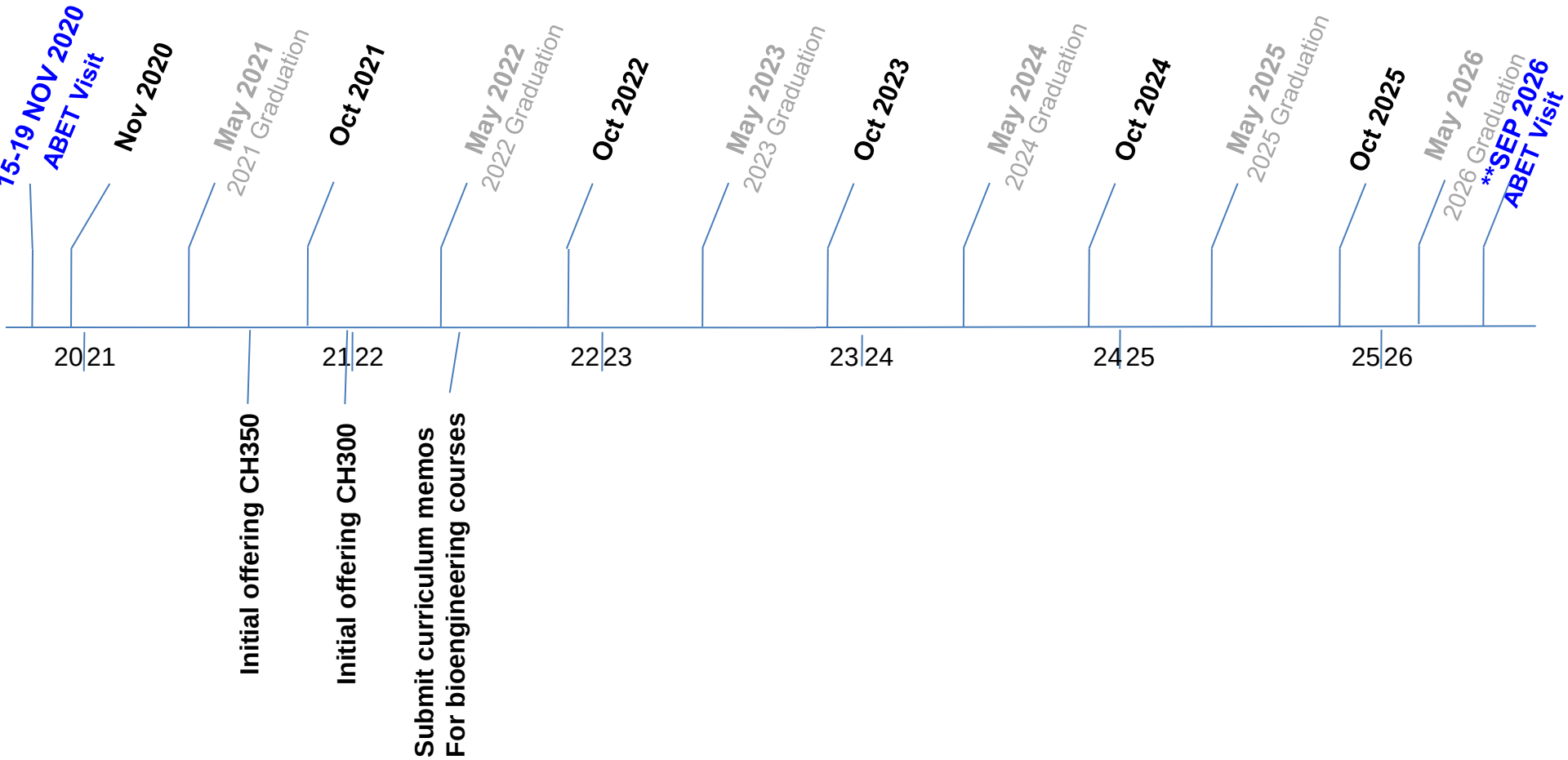
- **Student Outcomes**
  - What students should be able to do **at graduation**
  - Must be **measurable**
  - Designed to lead naturally to the PEOs
  - Assess/evaluate some fraction yearly.
- **Assessment → Continuous improvement**
  - Collect meaningful data to evaluate performance indicators (PIs)
  - Assess PIs for outcome attainment → information → COAs for change
  - Implement change
  - Assess its effects and level of success (“closing the loop”)
  - Repeat all the above
  - Periodically check and adjust both Student Outcomes and PEOs

Assessment Cycle



UNITED STATES MILITARY ACADEMY
WEST POINT

Timeline of Curricular Actions



UNITED STATES MILITARY ACADEMY
WEST POINT

CH300: Introduction to Biomedical Engineering

Course Director: TBD

Course OIC: MAJ Jeffrey Chin

Credit Hours: 3.0 (BS=0, ET=3.0, MA=0)
Prerequisites: CH102, MA205
Co-requisite: None

Lessons: 30 @ 75 min This course provides a basis for understanding the application of engineering principles to problems in medicine and biology. It provides preparation for future graduate work in medical school, biomedical engineering, and chemical engineering. Specifically, the objectives of the course are: (1) to provide an introduction to the field and how it relates to other fields of engineering and science, (2) the develop the ability to apply mathematics, science, and engineering to solve problems, (3) to develop an understanding of the impact of engineering solutions on the medical field and society as a whole, and (4) to understand current topics within the field.

Assessment – Graded Events

6 *HWs@ 50 pts each	300	21.4%
2 *WPRs @ 200 pts each:	400	28.6%
1 *Capstone	200	14.3%
1 *TEE	500	35.7%
Total:	1400	
*Individual Points :	1400	100%

TEXT: Biomedical Engineering, 2nd Edition, by W. Mark Saltzman; Cambridge University Press, 2015.

COA 1

Block I: Molecular and cellular principles
- Biomolecular principles (Ch. 2)
- Biomolecular principles: Nucleic acids (Ch. 3)
- Biomolecular principles: proteins (Ch. 4)
- Cellular principles (Ch. 5)

Block II: Physiological principles
- Communication systems in the body (Ch. 6)
- Engineering balances: respiration and digestion (Ch. 7)
- Circulation (Ch. 8)
- Removal of molecules from the body (Ch. 9)

COA 2

Block I: Molecular and cellular principles
- Biomolecular principles (Ch. 2)
- Biomolecular principles: Nucleic acids (Ch. 3)
- Biomolecular principles: proteins (Ch. 4)
- Cellular principles (Ch. 5)

Block II: Physiological principles
- Communication systems in the body (Ch. 6)
- Engineering balances: respiration and digestion (Ch. 7)
- Circulation (Ch. 8)
- Removal of molecules from the body (Ch. 9)

Block III: Biomedical Engineering
- Biomechanics (Ch. 10)
- Bioinstrumentation (Ch. 11)
- Bioimaging (Ch. 12)
- Biomolecular Engineering I: Biotechnology (Ch. 13)
- Biomolecular Engineering II: Engineering of Immunity (Ch. 14)

UNITED STATES MILITARY ACADEMY
WEST POINT

CH350: Introduction to Bioengineering

Course Director: Dr. Simuck Yuk

Credit Hours: 3.0 (BS=0, ET=3.0, MA=0)
Prerequisites:
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

The purpose of this course is to provide the introductory knowledge for understanding the biotechnology/bioprocessing engineering. Topic includes enzyme kinetics, molecular biology, cell growth, bioreactors, and bioprocesses. The bioprocess control and its application to different biological systems are covered in the classroom instruction. An important emphasis is made on the use of kinetics and process controls on the biological systems for engineering application.

Topics – by Chapter

Bioprocess Engineering Basic Concepts, 3rd Ed., by Michael L. Shulter, Fikret Kargi, Matthew DeLisa, Prentice Hall.

Quantitative Fundamentals of Molecular and Cellular Bioengineering, by K. Dane Wittrup, Brice Tidor, Benjamin J. Hackel, and Casim A. Sarkar, The MIT Press.

- Introduction
- Enzyme Kinetics
- Central Dogma to Molecular Biology
- Cell Growth
- Bioreactor Selection
- Bioprocess Consideration

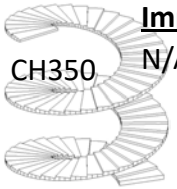
Course Assessment – Items from Section III

Sustain:

N/A at this point.

Improve:

N/A at this point.



Assessment – Graded Events

1 *Capstone Presentation	200	14%
2 *WPRs	400	28%
5 *After-class Problem Sets(20pts/ea.)	100	7%
5 *In-class Problem Sets (50pts/ea.)	250	17%
1 *Term End Exam	500	34%
Total:	1450	100.00%

UNITED STATES MILITARY ACADEMY
WEST POINT

CH450: Bioengineering Modeling and Analysis

Course Director: COL John Burpo

Credit Hours: 3.0 (BS=0, ET=3.0, MA=0)
Prerequisites: CH102, MA205
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

This course provides a broad understanding of bioengineering disciplines to include biomechanics, biomaterials, tissue engineering, biocatalysis, biochemical engineering, and biosensors. Fundamental concepts of molecular kinetics, thermodynamics, and mass transport are applied in problem sets in each bioengineering sub-discipline and capstone design project providing students the opportunity for modeling, analysis, and design from the biomolecular to physiological length scale and across multiple time scales. Modeling software such as MATLAB and Mathematica is extensively used.

Topics – by Chapter

TEXT: Introduction to Biomedical Engineering, 3rd Edition, by John Enderle and Joseph Bronzino; Academic Press, 2012.

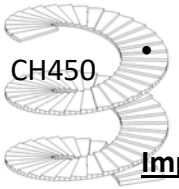
- Part I: Biomechanics (Ch. 1 and 4)
- Part II: Biomaterials (Ch. 5)
- Part III: Tissue Engineering (Ch. 6)
- Part IV: Biomedical Enzyme Kinetics (Ch. 7 and 8)
- Part V: Biochemical Engineering (Handouts)
- Part VI: Biosensors (Ch. 10)

Course Assessment – Items from Section III

Sustain:

- Best looking Dept Head/ CD/ Prof at the academy
- Strong instructor personal experience in mathematics, engineering, and chemistry
- Each lesson considers interdisciplinary science and engineering topics –science topics are taught in context of engineering applications

Improve:



Assessment – Graded Events

5 *Problem Sets@ 25 pts each	500	47.2%
6 *Quizes @ 200 pts each:	180	17.0%
1 *Paper	150	14.1%
1 *Presentation	50	4.7%
6 *Discussion	180	17.0%
Total:	1060	
*Individual Points :	1060	100%

Advisory Board Findings

Excerpts from Minutes of 26 April 2019

- CH400 professional practice was discussed at length with cadet panel; and faculty; overall stay on current azimuth
- Desire for continued program improvement; program has good balance between theory and hands-on experience
- Some members of board would like to see more flexibility
- Cadets lamented about lack of chemical engineering electives
- Cadet feedback focused on various courses
- Cadets appreciate going to other departments for some courses (CME)
- General Chemistry discussion
- CH485 tough but useful and important to curriculum

End of Section 1

Chemical Engineering

Advisory Board Meeting

23 April 2021

2. Program Assessment

United States Military Academy
Department of Chemistry and Life Science

Student Outcomes (new used for AY19 & beyond)

Identical to ABET 1-7 plus one additional outcome (8)

On completion of the chemical engineering program, our graduates will be able to:	
1.	Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2.	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.	Communicate effectively with a range of audiences.
4.	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.	Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6.	Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7.	Acquire and apply new knowledge as needed, using appropriate learning strategies.
8.	Understand the chemical engineering curriculum, including chemistry, material and energy balances, safety and environmental factors, thermodynamics of physical and chemical equilibria, heat, mass, and momentum transfer, chemical reaction engineering, continuous and staged separation processes, process dynamics and control, modern experimental and computing techniques, and process design.

Required Courses *	(for classes 2020 and beyond)
MA364	Engineering Mathematics
CH362	Mass & Energy Balances
CH363	Separation Processes
CH364	Chemical Reaction Engineering
CH367	Introduction to Automatic Process Control (XE472 2019 and previous)
CH485	Heat & Mass Transfer
CH459	Chemical Engineering Laboratory
CH402	Chemical Engineering Process Design
CH400	Professional Practice
MC311	Thermal-Fluid Systems I
MC312	Thermal-Fluid Systems II
EE301	Fundamentals of Electrical Engineering
MC300	Fundamentals of Engineering Mechanics & Design (Statics & Dynamics)
CH365	Chemical Engineering Thermodynamics
CH383	Organic Chemistry 1

***Not including prerequisites**

UNITED STATES MILITARY ACADEMY
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CDT Matthew Dibiase, ’20
Chemical Engineering

- **Goldwater Scholarship Recipient**
- **Fullbright Scholarship Semifinalist**
- **Phi Kappa Phi Honor &Tau Beta Phi Honor Society**

Co-Authored Conference Proceedings and Publications

1. Army Research Lab (ARL) Technical Symposium “Catalysts for fuel cell electronics”. (Poster)
2. 1st Place Catalysts and Reaction Engineering, Presentation: “Nickel catalysts and graphene for lithium ion batteries”. American Institute of Chemical Engineering Annual Meeting, Orlando, FL, 10-15 NOV19.
2. Manuscript in progress, “Electroless deposition of Noble Metal Nanoparticles onto Silk Fibroin Films”, (*to be submitted, Spring 2020)*

CH290: Modeling; Rheology of Blood
CH389/390: Fuel Cell Polymers
AIAD: ARL, Nickel Based Catalysts
CH490: Functionalized Graphene

Fourth Class | **Third Class** | **Second Class** | **First Class** | **Beyond**

CH290 | **CH389/CH390** | **CH489/CH490**

Future Signal Officer

<u>USMA Independent Research</u>

Cadet Dibiase has been working on a Proton Exchange Membrane (PEM) Fuel Cell project; a field of great interest for their efficiency advantages over combustion technology. However, conventional methods of electrolysis to produce H_2 and O_2 gas necessary for PEM fuel cells rely on expensive catalysts, Pt and IrO_2. Despite exceptional efficiency of these catalysts, their high costs prevent industry scale up and production. We present alternative Ni-based catalysts to replace Pt and IrO2. Of the Ni catalysts characterized, NiS and NiFe LDH together provided the smallest total overpotentials of 1.7 V (vs SHE) for Hydrogen Evolution Reactions (HER) and Oxygen Evolution reactions (OER), respectively. However, Linear Sweep Voltammetry illustrated that NiFe LDH had the lowest overpotential of the two, contributing only 0.3 V to the total overpotential. Nevertheless, the total overpotential of 1.7 V is still only 0.2 V above the industry standard of 1.5 V from a combination of Pt and IrO_2.

Future Faculty

Assessment

CHEME Coursework Embedded Indicators

MECHE Coursework Embedded Indicators

Fundamentals of Engineering Exam Topics

Participation in FE Exam (not pass rate)

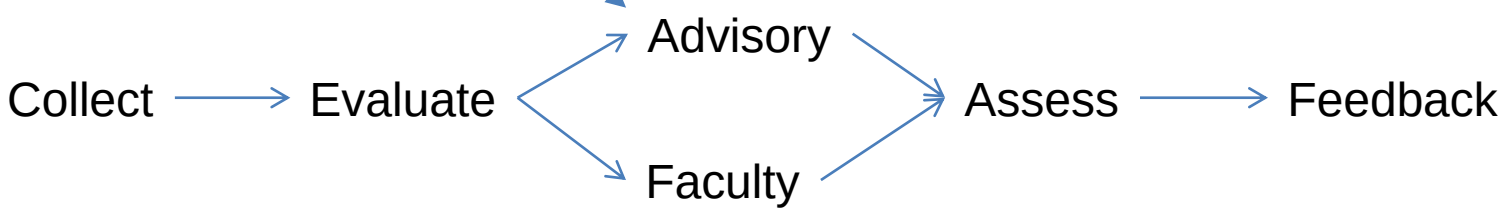
Student end of semester surveys

Student CHEME Program Exit Surveys

Course Grades

Where we are now

Process



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Chemical Engineering 8TAP

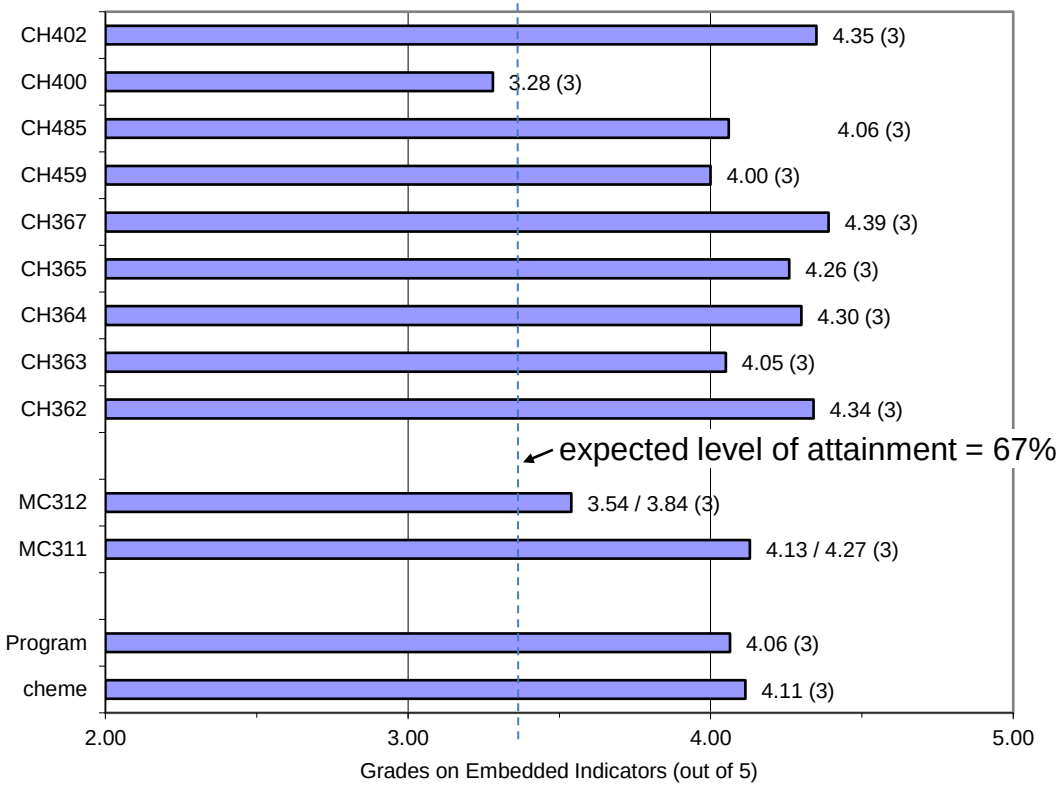
Example Schedule for Chemical Engineering, Classes of 2021 and Beyond

Fall Term 4th CLASS	Course	Credit Hours	Spring Term	Course	Credit Hours
MA103	Math. Modeling & Intro. Calculus	4.5	MA104	Calculus I	4.5
CH101	General Chemistry I	4.0	CH102	General Chemistry II	4.0
EN101	Composition	3.0	EN102	Literature	3.0
HI107	Western Civilization	3.0	HI108	Regional Studies in World History	3.0
IT105	Introduction to Computing & IT	3.0	PL100	General Psychology	3.0
PE11x	Combatives / Boxing / Movement	0.5	MS100	Introduction to Warfighting	1.5
			PE150	Fundamentals/Personal Fitness	1.5
3rd CLASS		Total 18.0			Total 20.5
MA205	Calculus II	4.0	*CH362*	*Mass and Energy Balances*	*3.5*
PH205	Physics I	4.0	*MA364*	*Applied Engineering Math*	*3.0*
Lx203	Foreign Language	4.0	PH206	Physics II	4.0
SS201	Economics	3.0	Lx204	Foreign Language	4.0
PY201	Philosophy	3.0	SS202	American Politics	3.0
MS200	Fundamentals: Army Operations	1.5	EV203	Physical Geography	3.0
			PE 2xx	Lifetime Physical Activity	0.5
2nd CLASS		Total 19.5			Total 21.0
CH363	*Separation Processes*	*3.5*	*CH364*	*Chemical Reaction Engineering*	*3.5*
EE301	*Fundamentals of Electrical Engineering*	*3.5*	*CH367*	*Introduction to Automatic Process Control*	*3.0*
CH383	*Organic Chemistry 1*	*3.5*	*MC312*	*Thermal-Fluid Systems 2*	*3.0*
MC311	*Thermal-Fluid Systems 1*	*3.5*	*MC300*	*Fundamentals of Eng. Mech. & Design*	*3.0*
PL300	Military Leadership	3.0	SS307	International Relations	3.0
MA206	Probability and Statistics	3.0	MS300	Platoon Operations	1.5
PE32x	Survival Swimming	0.5	PE360	Combat Applications	1.5
1st CLASS		Total 20.5			Total 18.5
CH459	*Chemical Engineering Laboratory*	*3.5*	*CH402*	*Chemical Engineering Process Design*	*3.5*
CH365	*Chemical Engineering Thermodynamics*	*3.0*	*CH400*	*Chemical Engineering Prof. Practice*	*1.5*
CH485	*Heat & Mass Transfer*	*3.5*	*Elective*	*Engineering Elective 3*	*3.0*
Elective	*Engineering Elective 1*	*3.0*	HI302	History of the Military Art	3.0
Elective	*Engineering Elective 2*	*3.0*	LW403	Constitutional & Military Law	3.0
PE450	Army Fitness Development	1.5	MX400	Officership	3.0
		Total 17.5			Total 17.0

Example Data: Coursework Embedded Indicators

Student Outcome 1

Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.



Values in parentheses are coverage ratings from Table 5-3 in the 2014 Self Study, page 5-9, updated for 2019.

Rubric:.

3: Unique embedded indicator with clear rubric or cut scale.

2: Outcome was graded but grades are convoluted, or part of the outcome is not covered.

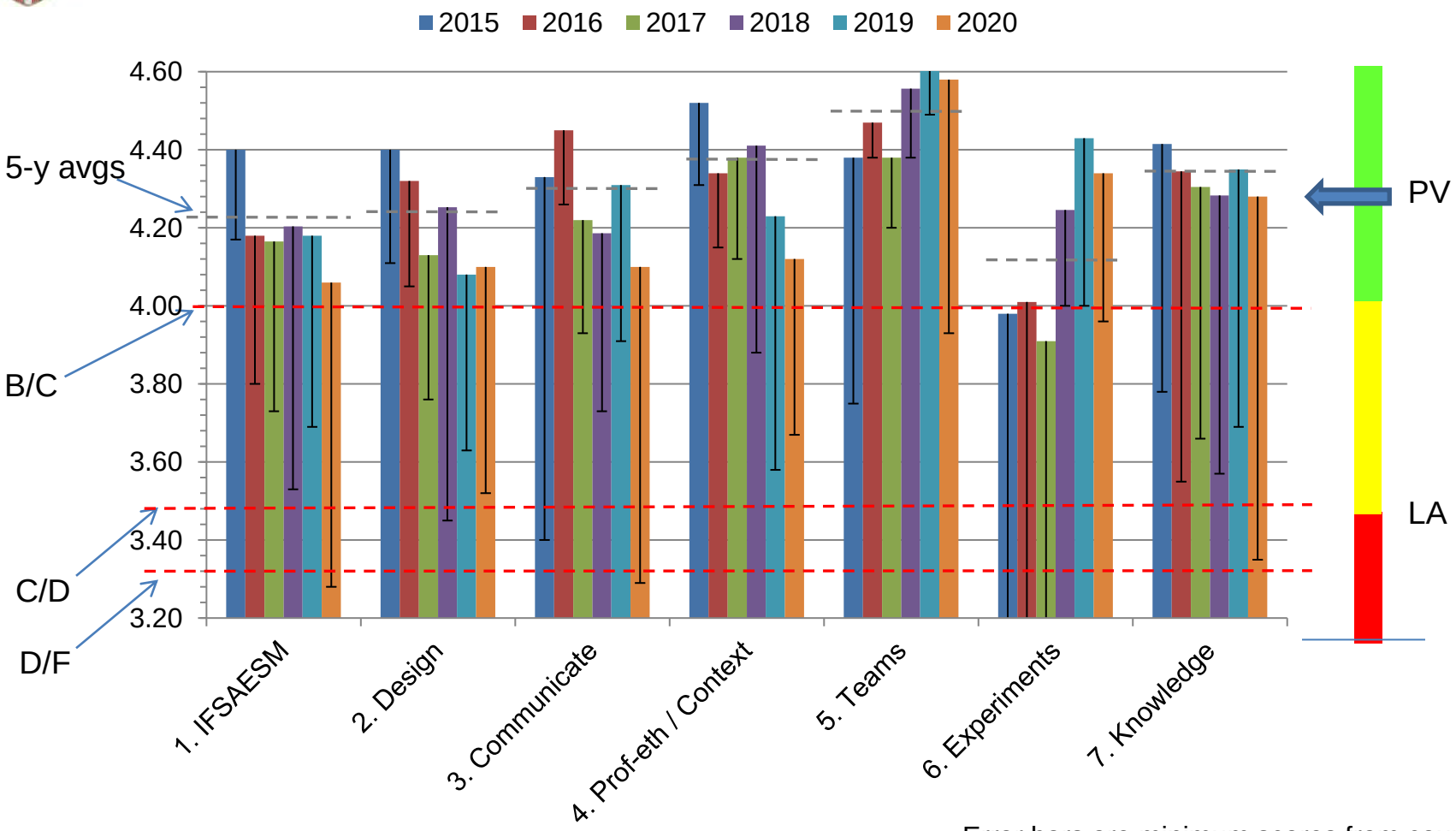
1: Correlation to outcome but no assessment

0: No coverage or correlation

Data shown here is for Class of 2020
Similar data is collected for all 7 ABET student outcomes
Summary of all data is shown on next slide

Performance on Embedded Indicators

Program Averages AY2015-20

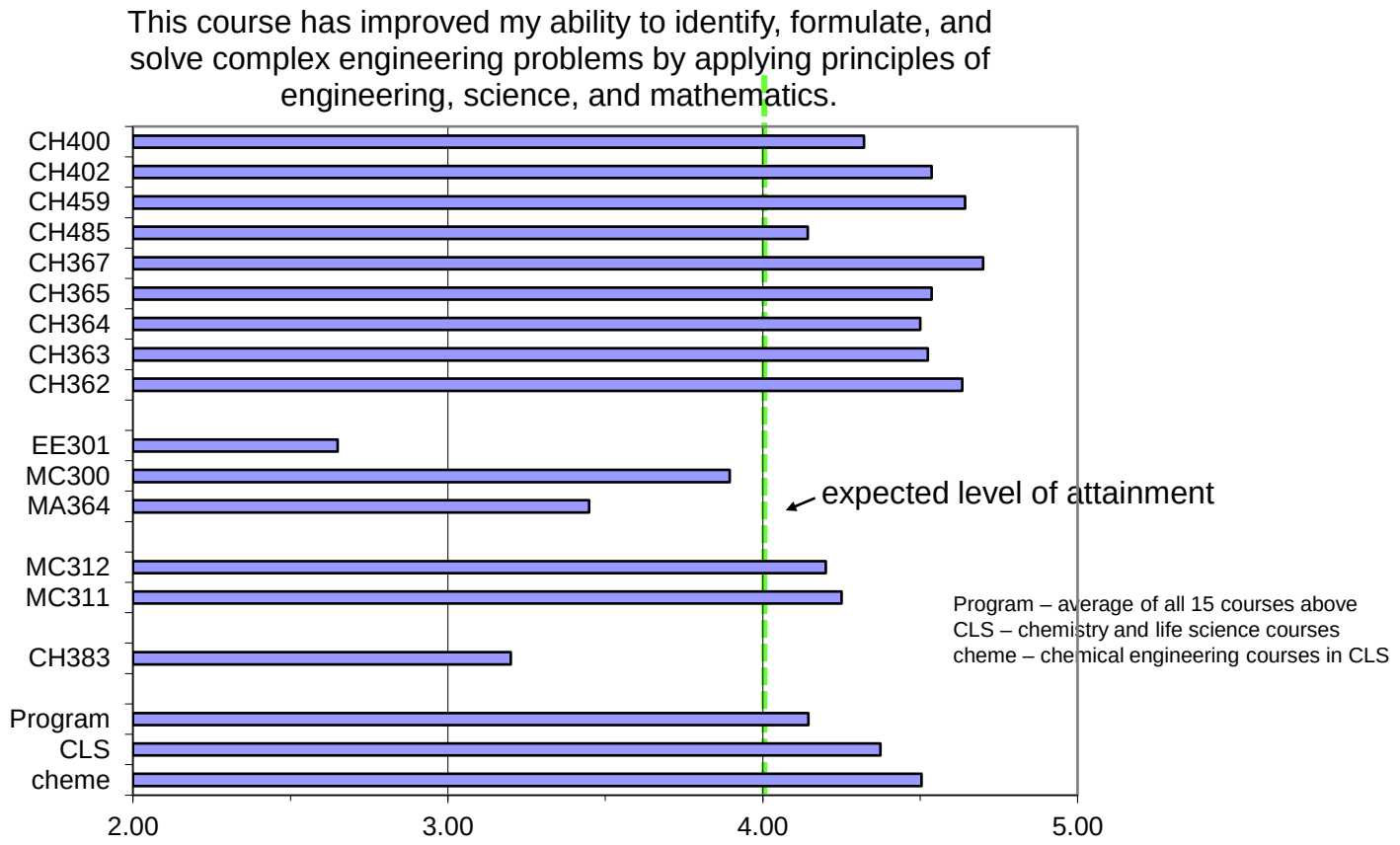


Error bars are minimum scores from courses.

Expected levels of attainment are the 5-year averages

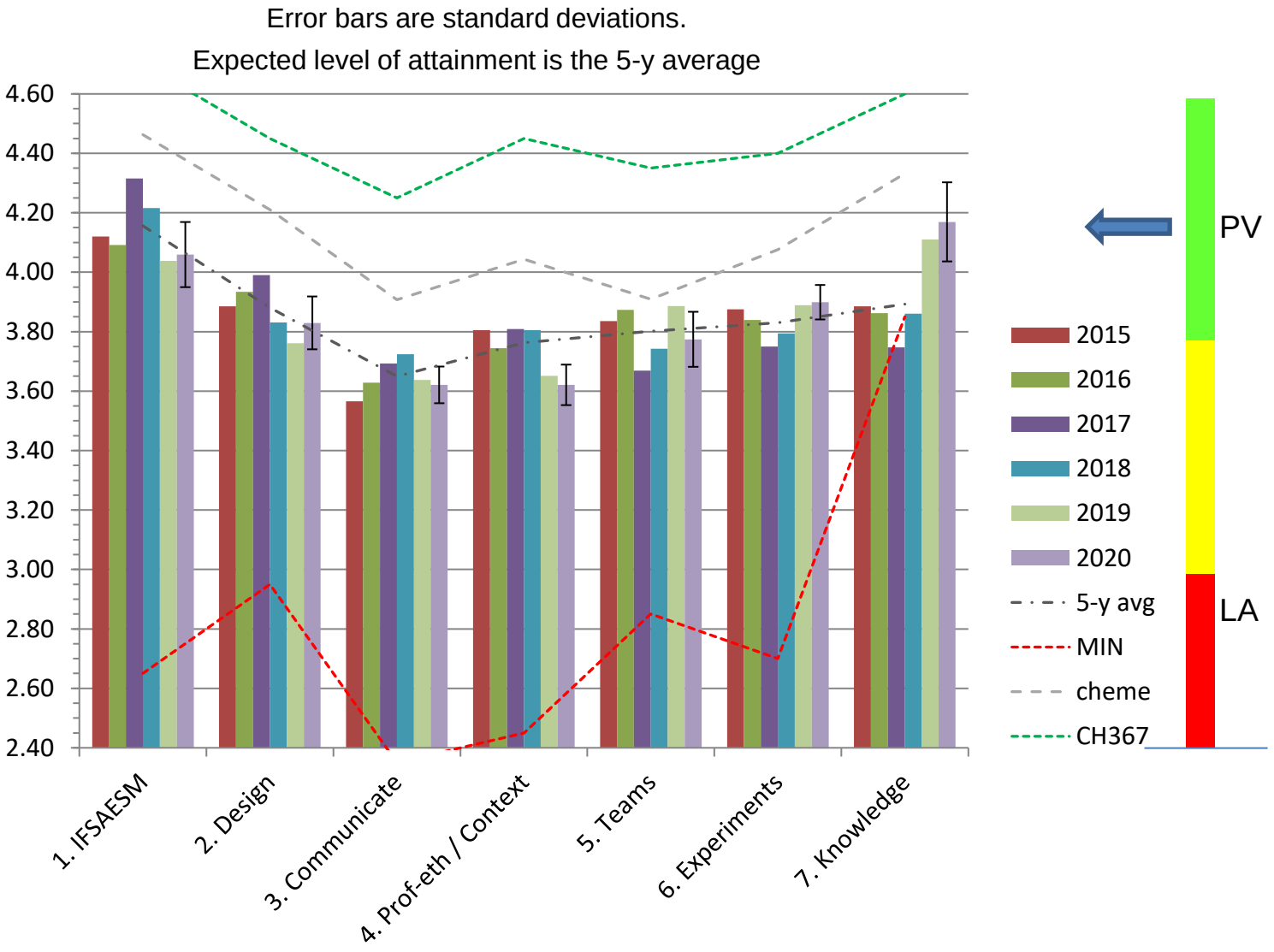
Example Data: End-of-Semester Surveys

Student Outcome 1



Data shown here is for Class of 2020
Similar data is collected for all 8 ABET student outcomes
Summary of all data is shown on next slide

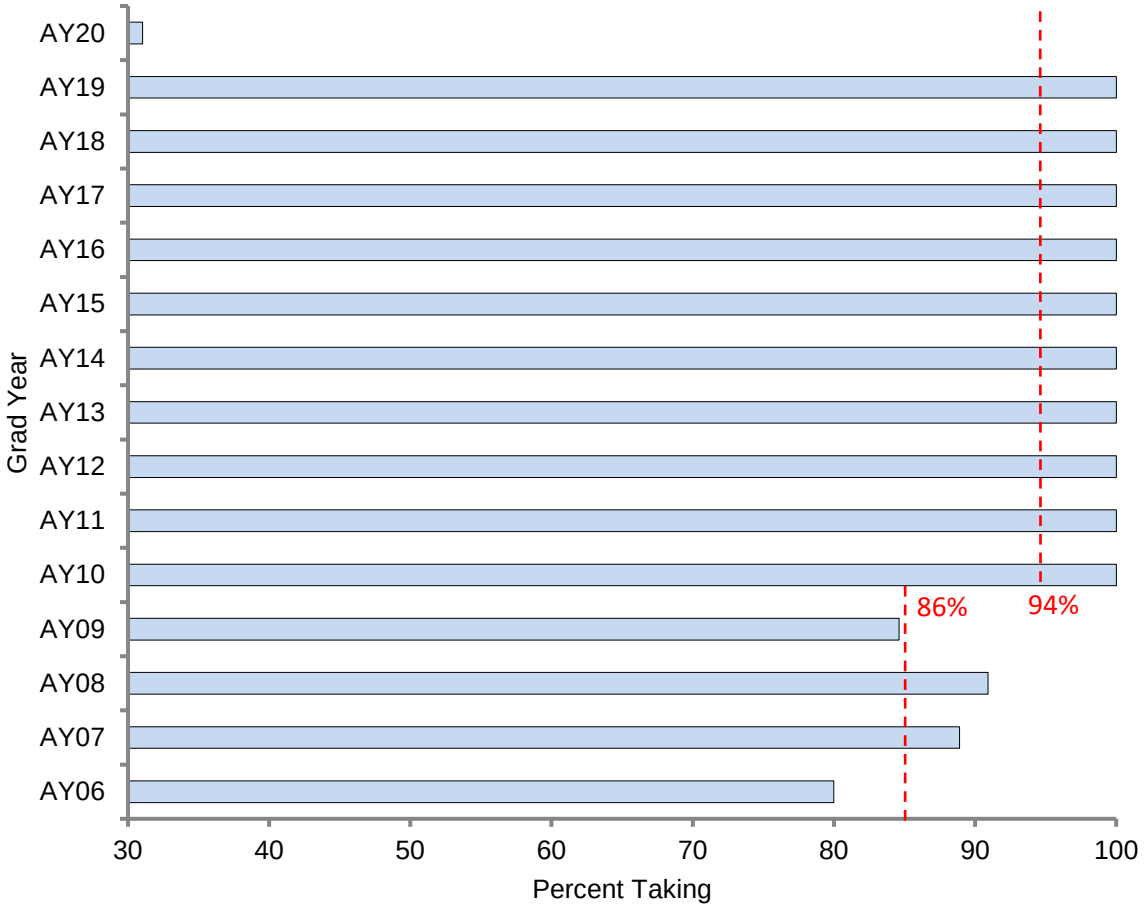
End-of-Semester Surveys Program Aves. From AY15-20



Fundamentals of Engineering Exam

Student Outcome 7: Acquire and apply new knowledge as needed, using appropriate learning strategies

Percent of cadets taking the FE Exam



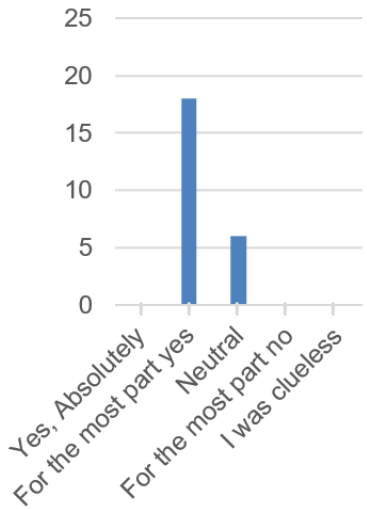
Fundamentals of Engineering Exam

Student Outcome 7: Acquire and apply new knowledge as needed, using appropriate learning strategies

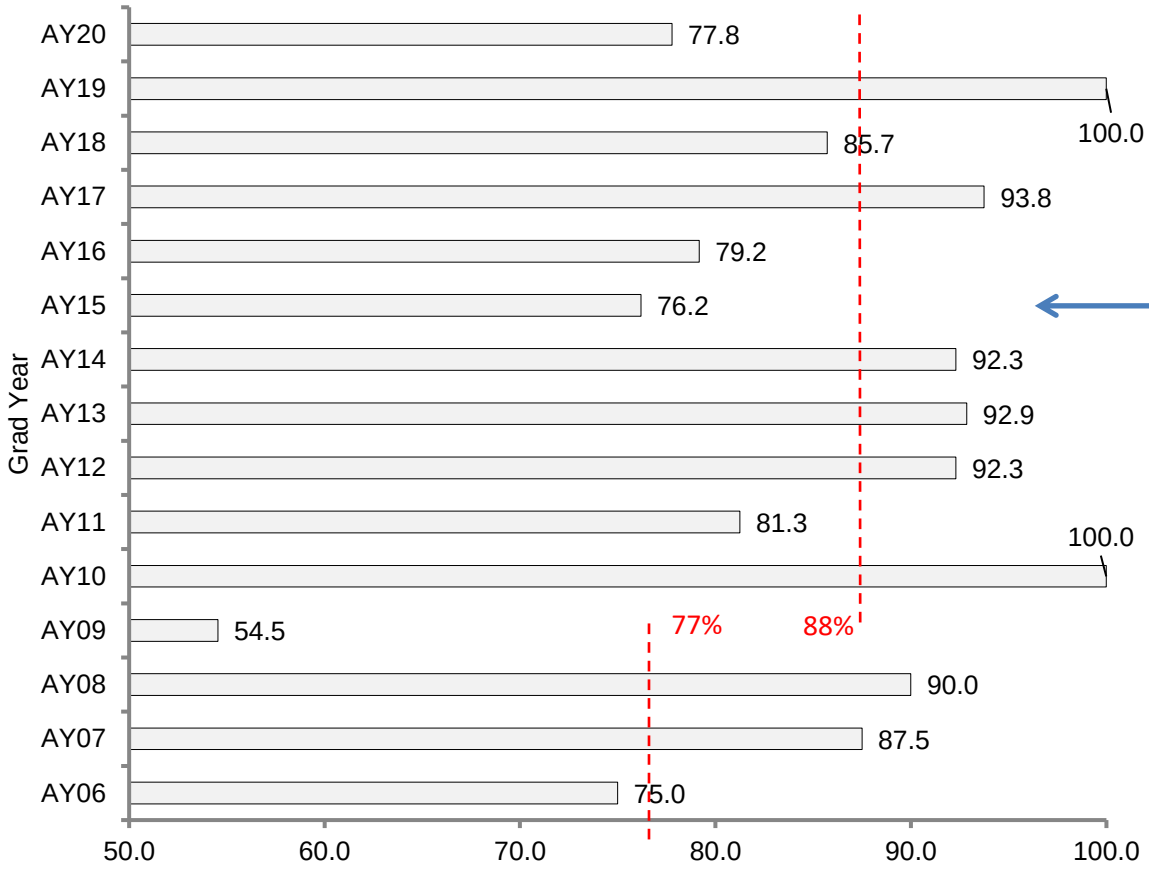
National, (+/- ~1%):

2020	74.6%
2019	77.0%
2018	75.0%
2017	74.0%
2016	79.0%
2015	77.4%
---	---
2014	89.0%
2013	86.3%
2012	85.1%
2011	87.0%
2010	87.0%
2009	84.0%
2008	87.0%
2007	87.0%
2006	87.0%

Question 4



Percent of cadets passing the FE Exam



Electronic Testing Initiated

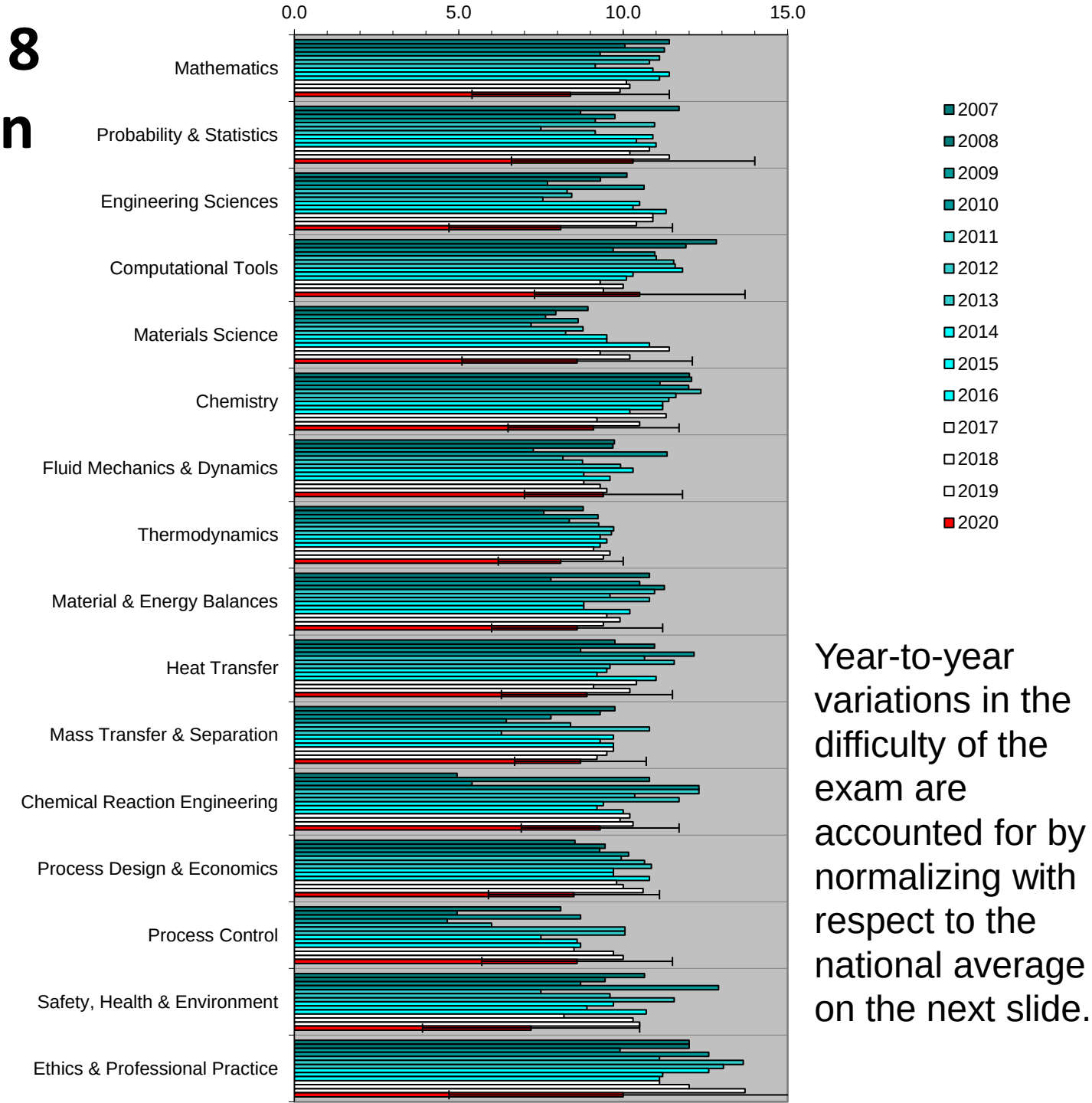
CH400 Initiated

Question 4, Post FEE Survey: For the questions on the exam that seemed new to you, were you able to learn the material on the spot?

Outcome 8 Evaluation

FEE Results by Topic

AY07 to AY20



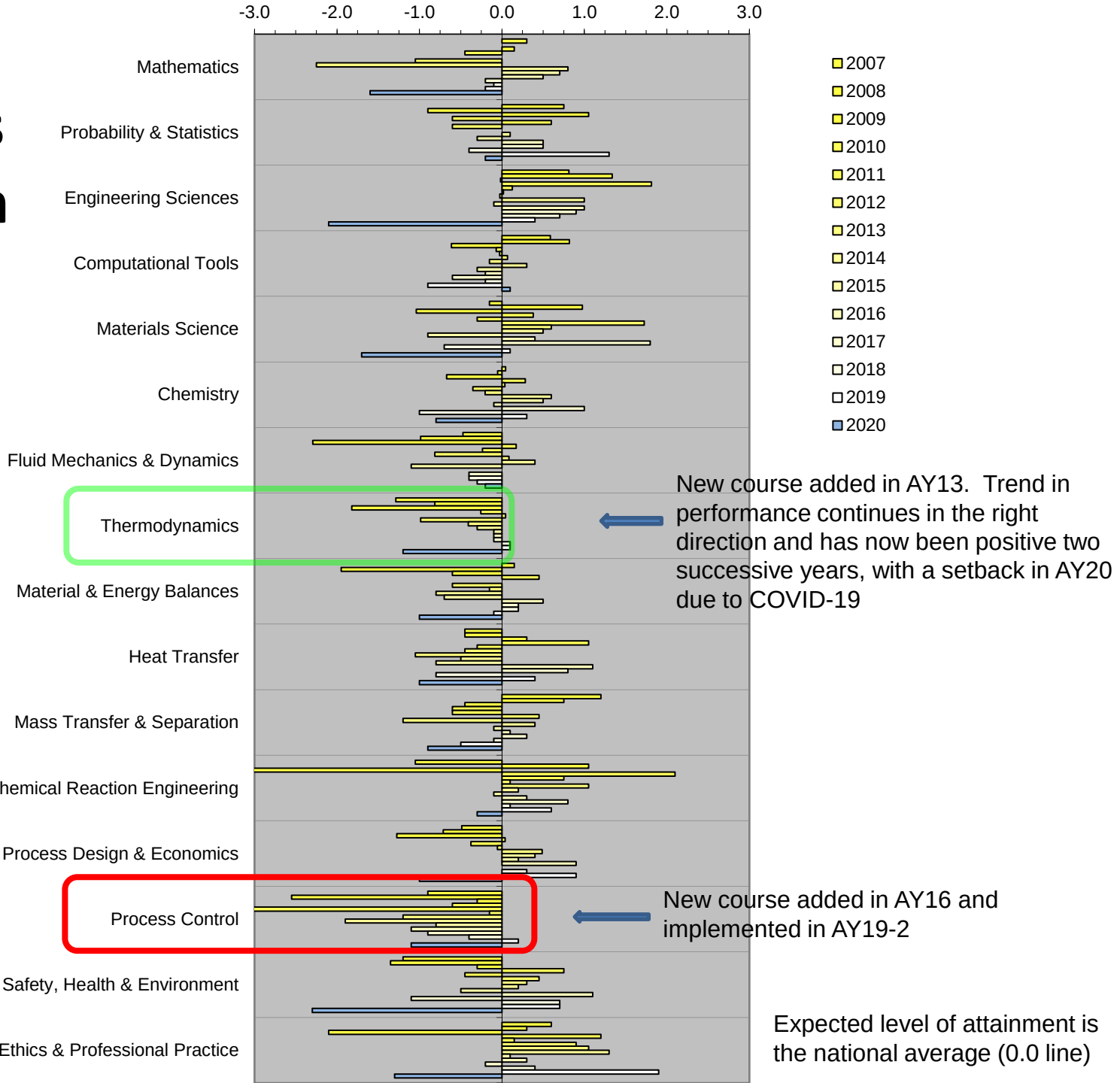
The error bars are the individual standard deviations for the AY20 data.

The average standard deviation over all data is 3.0.

Year-to-year variations in the difficulty of the exam are accounted for by normalizing with respect to the national average on the next slide.

Topical Outcomes Evaluation

Deviations from National Averages AY07 to AY20



New course added in AY13. Trend in performance continues in the right direction and has now been positive two successive years, with a setback in AY20 due to COVID-19

New course added in AY16 and implemented in AY19-2

Expected level of attainment is the national average (0.0 line)

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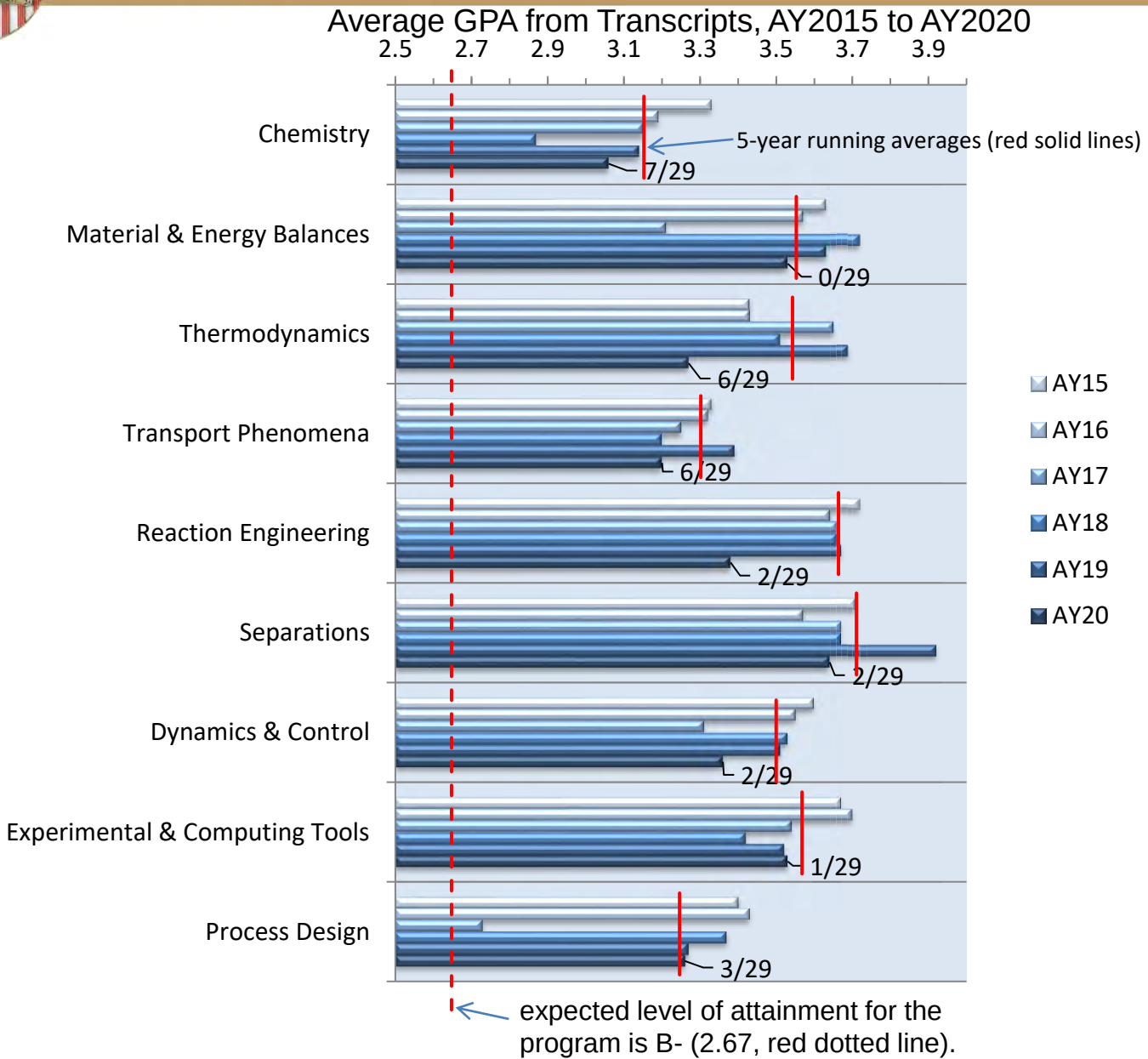
Topical Outcomes Evaluation

Student Outcome 8: Understanding of the Chemical Engineering Curriculum



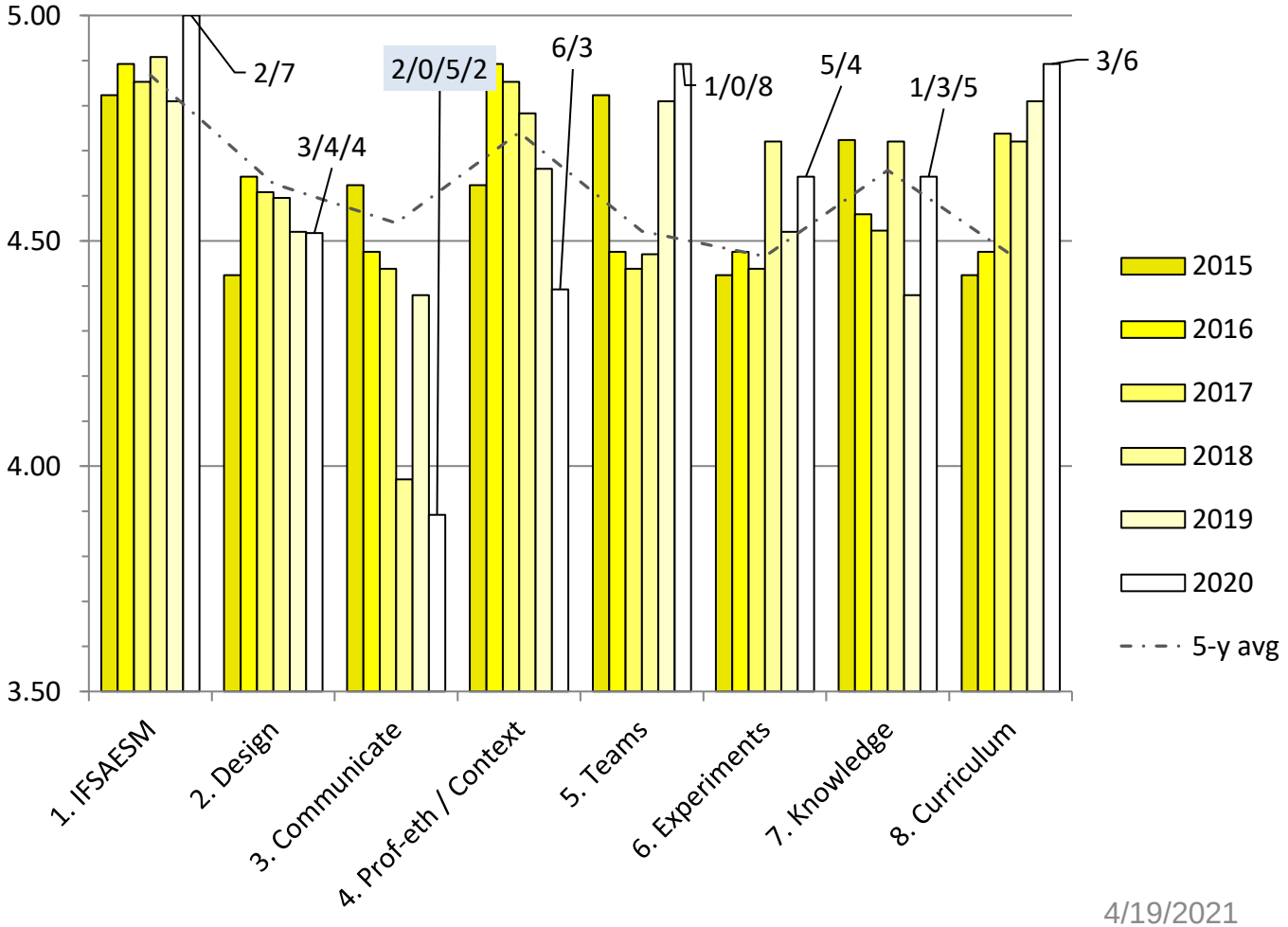
Letter Grade	Grade Point Conversion:
A+	4.33
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33
C	2.00
C-	1.67
D	1.00
F	0.00

Faculty Student Outcomes Surveys

Student Outcomes 1-8

Program Averages from AY15-20

Data labels are response frequencies for 2-5 on the 1-5 Survey Likert Scale (# of 2 / # of 3 / # 4 / # of 5)
Standard deviations range from .08 to .23

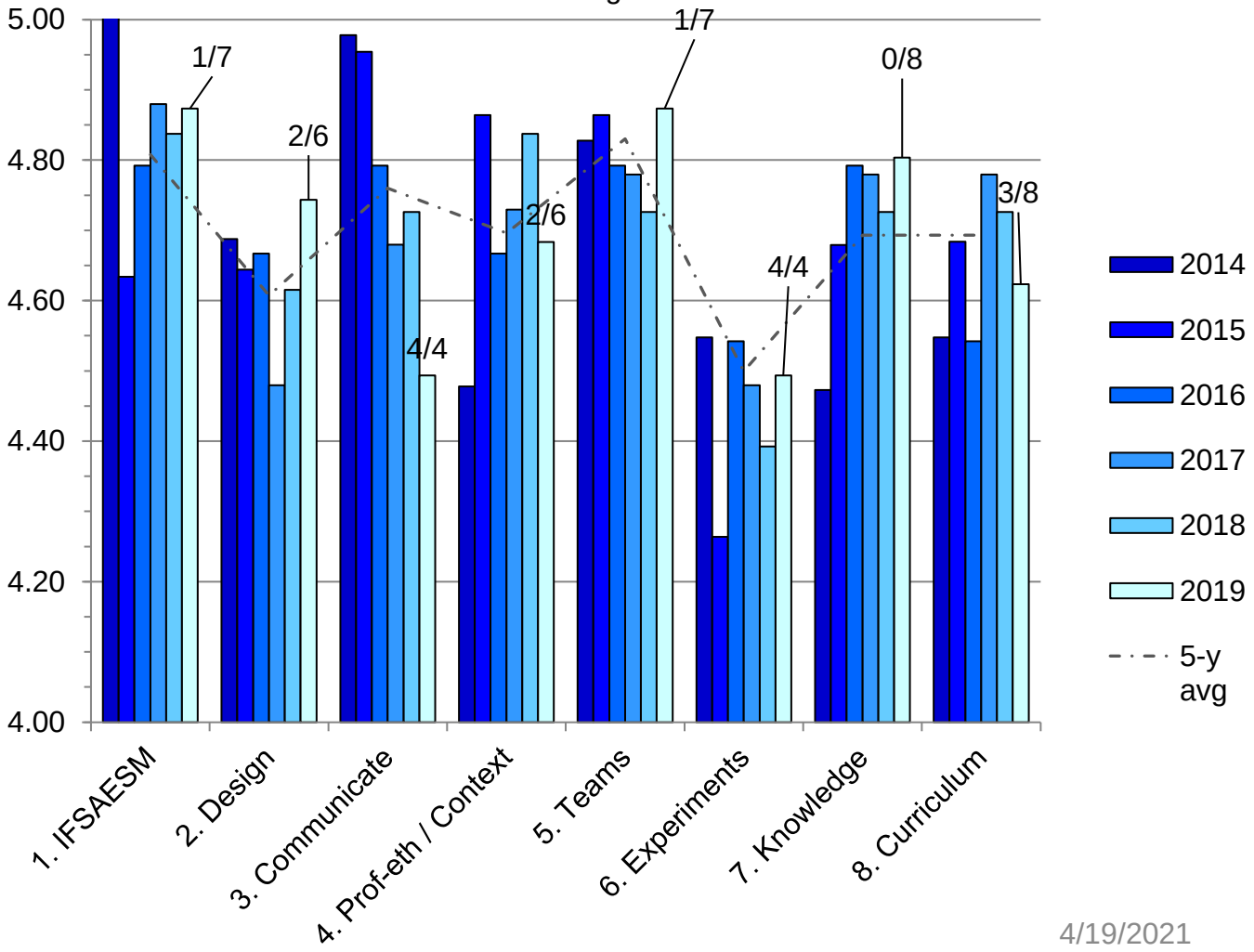


Advisory Board Student Outcomes Surveys

Student Outcomes 1-8

Program Averages from AY14-19

Data labels are response frequencies for 4 or 5 (# of 4s / # of 5s) on the 1-5 Survey Likert Scale
Standard deviations range from .26 to .53



Advisory Board Completes Survey Part 1

ABET Criterion 2: Objectives

The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria.

There must be a documented, systematically utilized, and effective process, involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria.

(ABET EAC Criteria)

Program Objectives (Current Redbook)

During a career as commissioned officers in the United States Army and beyond, program graduates:

1. Demonstrate effective leadership and chemical engineering expertise.

2. Contribute to the solution of infrastructure and operational problems in a complex operational environment.

3. Succeed in graduate school or advanced study programs.

4. Advance their careers through clear and precise technical communication.

Advisory Board Recommended: October 2012

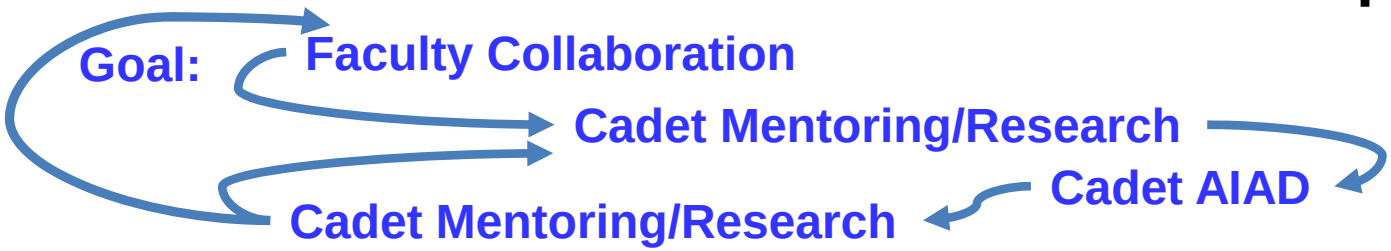
Assessment Instruments for Objectives

Program Surveys

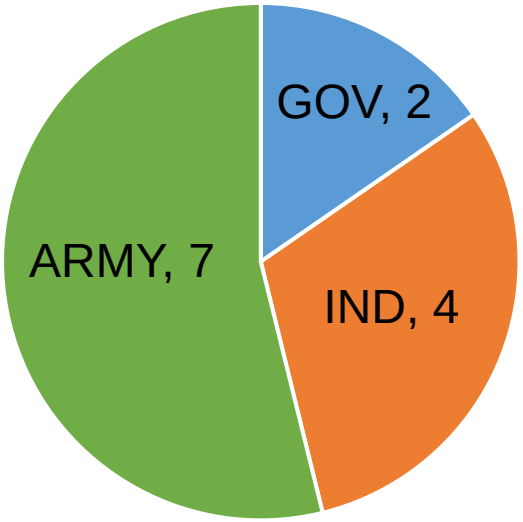
Program Advisory Board Surveys
Program Faculty Surveys
Program Cadet Surveys

Enrichment Opportunities

Advanced Individual Academic Development (AIAD)



- Lawrence Livermore National Lab
- Sandia National Lab
- Army Research Labs
- Picatinny Arsenal
- BAE Systems – Radford AAP
- BAE Systems – Holston AAP
- Southern Polymer
- Uniform Color Company
- Renewable Energy Group



Advisory Board Completes Survey Part 2

Board – Cadet Discussions

Concept (flexible) of discussions

~ 1000-1045 Board ask questions of cadets

Any courses in curriculum cadets are unhappy with?
Any general issues with the program they would like to discuss?

~ 1045-1115 Cadets ask questions of board

UNITED STATES MILITARY ACADEMY
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Lunch – Subs and Wraps

Lunch:

1. Cold cut Italian mix sandwiches and wraps
2. Mixed salad
3. Chips: regular/barbeque/sour cream & onion/Cheetos/Doritos
4. Iced tea/soda/water/coffee
5. Cookie plate

Chemical Engineering

Advisory Board Meeting

23 April 2021

4. Future Challenges

United States Military Academy
Department of Chemistry and Life Science

Academic Excellence

The Princeton Review

#1 Most Accessible Professors

#2 Best College Library

U.S.News & WORLD REPORT

#2 Top Public Schools (Liberal Arts)

#3 Best Undergrad Engineering Program

#4 Civil Engineering Program

#7 Mechanical Engineering Program

#19 National Liberal Arts College

Forbes.com

#1 Public College in the country

#6 Liberal Arts Universities

#11 In the Northeast

#14 Overall College in the country

UNITED STATES MILITARY ACADEMY
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Strategic Influence

Governmental Strategic Guidance
- President
- Congress
- Department of Defense
- Government Agencies (e.g., NSA, FBI, CIA, …)

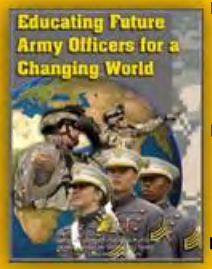
Department of the Army
- Army Goals and Priorities
- Army Regulations
- Army Doctrine

Higher Education Communities
- Professional Societies
- Accreditation Agencies
- Best Practices
- Peer Institutions

West Point Mission and Strategic Plan

Academic Program Vision and Strategic Plan

Academic Program Goals



- Core Courses
- Academic Majors
- Enrichment Experiences

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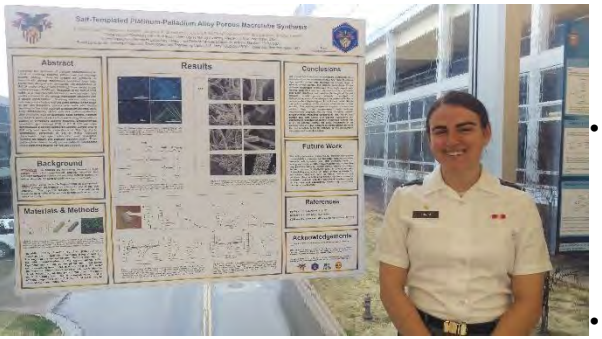
CDT Anchor Losch, ’20
Chemical Engineering



- **Fullbright Scholarship Semifinalist**
- **Anna Sobol Levy Scholarship**
- **Rotary Scholarship – Semifinalist**
- **Tau Beta Phi Honor Society**

Co-Authored Conference Proceedings and Publications

- F. John Burpo*, **Anchor R. Losch**, Enoch A. Nagelli, Stephen J. Winter, Stephen F. Bartolucci, Joshua P. McClure, David R. Baker, Jack Bui, Alvin R. Burns, Sean F. O’Brien, Brittany Aikin, Kelsey Healy, Alexander N. Mitropoulos, J. Kenneth Wickiser, Greg Forcherio, and Deryn D. Chu “Salt-Templated Synthesis Method fo Porous Noble Metal Platinum-based Macrobeams and Macrotubes.” *J. Vis Exp*. (Invited Paper)
- Burpo, F., Nagelli, E., **Losch, A.**, Bui, J., Forcherio, G., Baker, D., McClure, P., Bartolucci, S., Chu, D. “Salt-templated Cu-Pt Alloy Macrobeams for Ethanol Oxidation.” *Catalysts*, 2019, 9(8), 662.
- Burpo, F., Nagelli, E., Bartolucci, S., Mitropoulos, A., McClure, J., Baker, D., **Losch, A.**, Chu, D. “Salt-Templated Platinum-Palladium Porous Macrobeam Synthesis.” *MRS Communications*, 2019, 9(1), 280-287.

CH289/CH290: Multi-Functional Materials

CH489: Multi-Functional Materials

Fourth Class → **Third Class** → **Second Class** → **First Class** → **Beyond**

CH290 → **CH389/CH390** → **CH489/CH490** → **Future Engineer Officer**

USMA Independent Research and Activities

Cadet Losch researches in the Multi-Functional Materials Laboratory. She has completed synthesis work on Salt-Templated Platinum-Palladium and Copper-Platinum Alloy Porous Macrotubes, and presented at the Inter-Academy Chemistry Symposium and Projects Day. Outside of class and research, Anchor is a conductor in the Cadet Spirit Band, and President of the Model Arab League and American Institute of Chemical Engineers. As a part of the Peace and Dialogue Leadership Initiative, she has traveled to Israel and Palestinian territories to participate in a nuanced conversation about the US role in the Middle East, with a focus on Israeli-Palestinian relations, society, and culture. She studied Arabic abroad in Morocco, where she taught English at a local NGO. She travelled to Qatar with the National Council on U.S-Arab Relations on a cultural exchange program between U.S. and Qatari servicemembers. She also has completed service work in Viet Nam, Mongolia, Papua New Guinea, and the Galapagos Islands.

Future Faculty

ABET Criteria

- ABET Criteria changed this year, officially
  - Critical change is the reduction of dedicated engineering credit hours from 48.0 to 45.0

- Also, the Student Outcomes, what graduates of programs are expected to be able to do upon graduation, have changed
  - Fundamentally the same, but some consolidation, wording changes, and enhancements that may impact the collection of some assessment data
  - We already leaned forward to include the new SOs in our AY19 assessments, and are currently utilizing during AY20 record year.

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Chemical Engineering Faculty

	AY21	AY22	AY23	AY24	AY25	AY26	AY27
Burpo	X	X	X	X	X	X	X
Biaglow	X	X	X	X	X	X	
Lachance	a	?	?	?	?	?	?
Nagelli	X	X	X	X	X	X	X
James	X	X	X	X	X	X	X
Yuk	X	X	X	X	X	X	X
Corrigan	X						
Cowart	X	X	X				
Armstrong	X	X					
Chin	X	X	X				
Yi	X	X	X				
Bowers		X	X	X			
Mandes		X	X	X			
Belanger			X	X	X		
Rogers						X	X
Golonski					X	X	X
Totals	**10+**	**11+**	**11+**	**8+**	**7+**	**7+**	**6+**

a – available to teach; currently in registrar's office

? – uncertain availability

Effects of COVID: AY20/ AY21

- Spring AY20-2 transition to remote learning
- Cadets left for Spring Break 6MAR→ came back JUN20
- 10/30 Class of ’20 chemical engineers took FEE
- Fall AY21-1 was a combination of in person, fully remote and hybrid
- Fall AY21-1 no TEE in chemical engineering courses
- Spring AY21-2 first 10 days remote
- Hybrid/remote for remainder of Spring AY21-2 semester

Implementing Schedule Change

- Since AY19 the Academy's 1-day/2-day schedule has changed
  - Now 40x 1-days and 30x 2-days
  - **Some courses have shifted to a 30-lesson sequence (CH363; CH485), IOT deconflict cadet schedules**
- The additional 10 2-days are now 'Study Days'
- Biggest impact on Chemical Engineering is CH459 (ChemE Laboratory)
  - Back-to-back sections: experiment reset time?
- Major impacts to core classes, CH101/102
  - Full impact on base knowledge and understanding uncertain

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Chemical Engineering Program
10+ year vision

1. **Stabilized** at **~40** +/- (1-5) cadets per class year; if >40 establish OML; Recommended GPA: ~2.3

2. Chemical engineering **faculty**:
   a. Senior faculty: AP; 2nd time rotators; Associate Professors; Title 10s; PhDs. Teach chemical engineering course 3-6 years in a row.
   b. Junior faculty: 1st time rotators. Teach CH101/102 (not both); collaborate with Senior Faculty on research. No CH102 without CH101.
   c. Minimize churn; "Do less better."…Stability; efficiency; optimization; transparency

3. Curriculum:

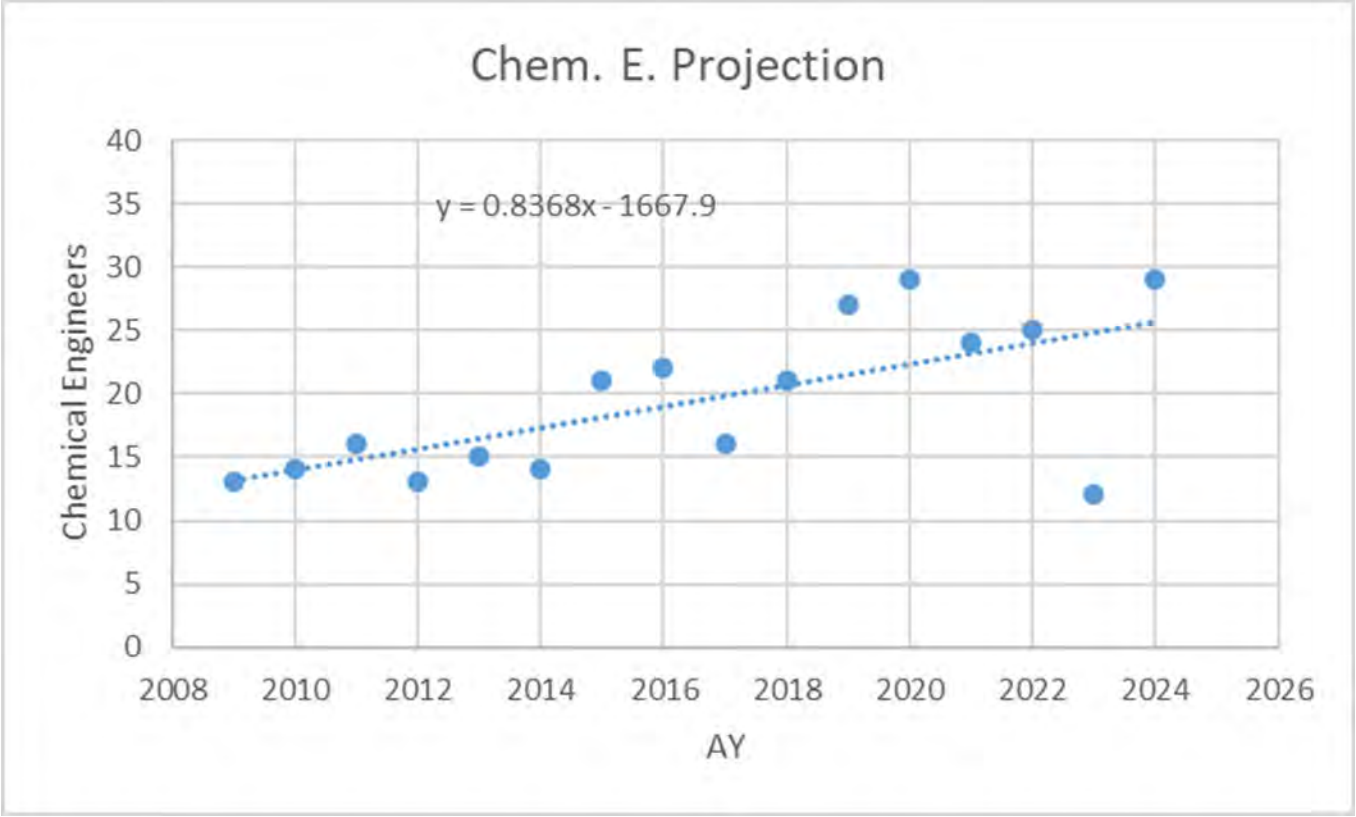
Bioengineering
   a. 3x Bio.-Eng. track: CH300, CH350, CH4; validate the ET credit
   b. Stand up bioengineering sequence
   c. Stand up bioengineering major
   d. Currently: Bio.-Eng. AP search; Ongoing Title10 hiring action

Chemical Engineering:
   a. Expand CH400 to 3.0 credits
   b. Expand CH459 to 4.0 credits – cadet feedback
   c. Expand CH402 to 7.0 credits (2 sem.)
   d. Other Chem E. electives: (Numerical methods; explosives)

4. Pedagogy:
   a. Intensive problem solving with instructors as coaches and role models
   b. classroom/lab workshop experience (theory + demo + practice)
   c. faculty <u>demonstrate</u> proficiency at problem solving as well as depth of knowledge; multi-year faculty development

5. **Ranked** undergraduate program
   a. ABET recertifications (15-19 NOV20); maintain ABET efforts; assessment; strength use of SSI software/CHEMCAD
   b. Establish "footprint" at National level conferences: AIChE; SOR; ACS & communicate USMA Chem. E. vision to other Universities
   c. Get more Chemical Engineers PEV training here (James, Nagelli)
   d. **Maintain** BH331 computer room; chemical engineering work/research space (Applications Rm.; BH136); Network

6. AIChE Club stability…and consistency of student involvement; strength of last ABET certification in 2014


Chem. E. Projection
y = 0.8368x - 1667.9
Chemical Engineers
AY
0
5
10
15
20
25
30
35
40
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026

Electives Proposals

- Cadets have expressed ongoing interest in more bioengineering electives
- Currently have 3 engineering electives in our major (to meet ABET requirements; 9 credit hours)
- ABET change lowered the required number of strictly engineering credit hours to 45
  - Options: retain engineering elective (at least in short term, will do so)? Chemistry elective? MSE at large? Others?

Other Electives / Thoughts

- **CH450** Bioengineering Modeling and Analysis added to Redbook (*more details next slide*)
- Numerical Methods for Chemical Engineering Problems
  - Enhance cadet experience with computational tools (MMA, Matlab)
  - Ready to execute
  - FEE data seems to support this
- Chemical Explosives
  - Taught before, ready to execute with instructor prep

CH300: Introduction to Biomedical Engineering

Course Director: TBD

Course OIC: MAJ Jeffrey Chin

Credit Hours: 3.0 (BS=0, ET=3.0, MA=0)
Prerequisites: CH102, MA205
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

This course provides a basis for understanding the application of engineering principles to problems in medicine and biology. It provides preparation for future graduate work in medical school, biomedical engineering, and chemical engineering. Specifically, the objectives of the course are: (1) to provide an introduction to the field and how it relates to other fields of engineering and science, (2) the develop the ability to apply mathematics, science, and engineering to solve problems, (3) to develop an understanding of the impact of engineering solutions on the medical field and society as a whole, and (4) to understand current topics within the field.

Assessment – Graded Events

6 *HWs@ 50 pts each	300	21.4%
2 *WPRs @ 200 pts each:	400	28.6%
1 *Capstone	200	14.3%
1 *TEE	500	35.7%
Total:	1400	
*Individual Points :	1400	100%

TEXT: Biomedical Engineering, 2nd Edition, by W. Mark Saltzman; Cambridge University Press, 2015.

COA 1

Block I: Molecular and cellular principles

- Biomolecular principles (Ch. 2)
- Biomolecular principles: Nucleic acids (Ch. 3)
- Biomolecular principles: proteins (Ch. 4)
- Cellular principles (Ch. 5)

Block II: Physiological principles

- Communication systems in the body (Ch. 6)
- Engineering balances: respiration and digestion (Ch. 7)
- Circulation (Ch. 8)
- Removal of molecules from the body (Ch. 9)

COA 2

Block I: Molecular and cellular principles

- Biomolecular principles (Ch. 2)
- Biomolecular principles: Nucleic acids (Ch. 3)
- Biomolecular principles: proteins (Ch. 4)
- Cellular principles (Ch. 5)

Block II: Physiological principles

- Communication systems in the body (Ch. 6)
- Engineering balances: respiration and digestion (Ch. 7)
- Circulation (Ch. 8)
- Removal of molecules from the body (Ch. 9)

Block III: Biomedical Engineering

- Biomechanics (Ch. 10)
- Bioinstrumentation (Ch. 11)
- Bioimaging (Ch. 12)
- Biomolecular Engineering I: Biotechnology (Ch. 13)
- Biomolecular Engineering II: Engineering of Immunity (Ch. 14)

CH350: Introduction to Bioengineering

Course Director: Dr. Simuck Yuk

Credit Hours: 3.0 (BS=0, ET=3.0, MA=0)
Prerequisites:
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

The purpose of this course is to provide the introductory knowledge for understanding the biotechnology/bioprocessing engineering. Topic includes enzyme kinetics, molecular biology, cell growth, bioreactors, and bioprocesses. The bioprocess control and its application to different biological systems are covered in the classroom instruction. An important emphasis is made on the use of kinetics and process controls on the biological systems for engineering application.

Topics – by Chapter

Bioprocess Engineering Basic Concepts, 3rd Ed., by Michael L. Shulter, Fikret Kargi, Matthew DeLisa, Prentice Hall.

Quantitative Fundamentals of Molecular and Cellular Bioengineering, by K. Dane Wittrup, Brice Tidor, Benjamin J. Hackel, and Casim A. Sarkar, The MIT Press.

- Introduction
- Enzyme Kinetics
- Central Dogma to Molecular Biology
- Cell Growth
- Bioreactor Selection
- Bioprocess Consideration

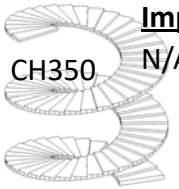
Course Assessment – Items from Section III

Sustain:

N/A at this point.

Improve:

N/A at this point.



Assessment – Graded Events

1 *Capstone Presentation	200	14%
2 *WPRs	400	28%
5 *After-class Problem Sets(20pts/ea.)	100	7%
5 *In-class Problem Sets (50pts/ea.)	250	17%
1 *Term End Exam	500	34%
Total:	1450	100.00%

CH450: Bioengineering Modeling and Analysis

Course Director: COL John Burpo

Credit Hours: 3.0 (BS=0, ET=3.0, MA=0)
Prerequisites: CH102, MA205
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

This course provides a broad understanding of bioengineering disciplines to include biomechanics, biomaterials, tissue engineering, biocatalysis, biochemical engineering, and biosensors. Fundamental concepts of molecular kinetics, thermodynamics, and mass transport are applied in problem sets in each bioengineering sub-discipline and capstone design project providing students the opportunity for modeling, analysis, and design from the biomolecular to physiological length scale and across multiple time scales. Modeling software such as MATLAB and Mathematica is extensively used.

Topics – by Chapter

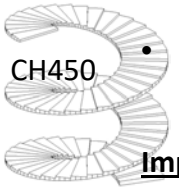
TEXT: Introduction to Biomedical Engineering, 3rd Edition, by John Enderle and Joseph Bronzino; Academic Press, 2012.

- Part I: Biomechanics (Ch. 1 and 4)
- Part II: Biomaterials (Ch. 5)
- Part III: Tissue Engineering (Ch. 6)
- Part IV: Biomedical Enzyme Kinetics (Ch. 7 and 8)
- Part V: Biochemical Engineering (Handouts)
- Part VI: Biosensors (Ch. 10)

Course Assessment – Items from Section III

Sustain:

- Best looking Dept Head/ CD/ Prof at the academy
- Strong instructor personal experience in mathematics, engineering, and chemistry
- Each lesson considers interdisciplinary science and engineering topics –science topics are taught in context of engineering applications



Improve:

Assessment – Graded Events

5 *Problem Sets@ 25 pts each	500	47.2%
6 *Quizes @ 200 pts each:	180	17.0%
1 *Paper	150	14.1%
1 *Presentation	50	4.7%
6 *Discussion	180	17.0%
Total:	1060	
*Individual Points :	1060	100%

Bioengineering Track

- **Bio-Engineer Title 10 Ph.D. Spring 2020**
- **Bioengineer Academy Professor Spring 2021**
- **Stand up bioengineering track (1-2 years)**
  - **CH300**
  - **CH350**
- **Bioengineering sequence (2-5 years)**
- **Bioengineering minor/ major (7 – 10 years)**

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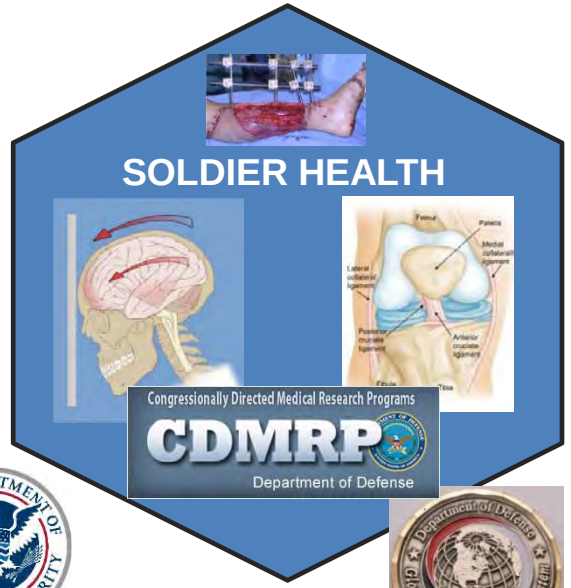
Undergraduate Research

Securing external resources through collaborations

Funded Collaborations:
UC Santa Barbara
Florida Institute of Technology
Cornell
University of Michigan



NCAA•DOD
Grand Alliance
CARE Consortium

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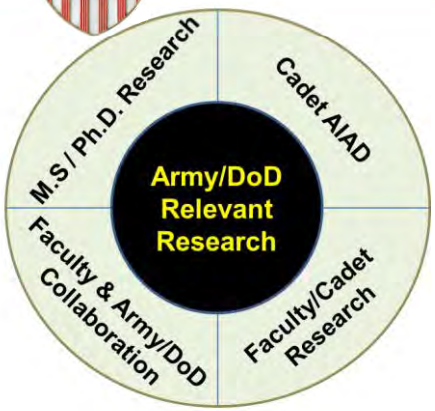
Promoting Cadet Development in Chem. E.



Faculty and Cadet Developmental Model

Principal investigators with DoD supporting projects, funding, and collaborators facilitate cadet research through a progressive series of courses – **CH290** (1 CR), **CH389/390** (1.5 CR), **CH489-492** (3 CR). This course progression allows cadets to begin research as early as their first year and participate in a multi-year project. Every effort is made to link research AIAD's with the collaborating DoD labs.

***Promoting Research and Scholarship**
- **10 Cadet co-authored papers in AY20**
- **24 Cadet conference proceedings AY20**
  - **AIChE; SOR; ACS**
  - **200/300/400 level research**

***Modeling Institutional Values**:
- Department Character development strategy
- **3 Leadership Challenge Facilitators**
- **3 PL300 Mentors (25 cadets)**
- **3 SLDP Developmental Coaches**

*Instituting **research-based instructional practices** to support APGs and WPLDS outcomes

***Engaging with Cadets**:
- **Club Affiliations: 3 Faculty/2 Clubs (1 OIC)**
- **USMA Chapters: AIChE and ACS**
- **ODIA Sport: 4 Faculty/ 4 Teams**
  - ***1 Head OR- Men's Hockey***
  - ***3 Asst. OR-Swimming & Diving***
  - ***Rifle***
  - ***Men's Basketball***
- **First-year Sponsorship Program: ~53 Cadets**
- **Unofficial Sponsor: >25**

Every interaction is a developmental event

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CDT Matthew Dibiase, ’20
Chemical Engineering

- **Goldwater Scholarship Recipient**
- **Fullbright Scholarship Semifinalist**
- **Phi Kappa Phi Honor &Tau Beta Phi Honor Society**

Co-Authored Conference Proceedings and Publications

1. Army Research Lab (ARL) Technical Symposium “Catalysts for fuel cell electronics”. (Poster)
2. 1st Place Catalysts and Reaction Engineering, Presentation: “Nickel catalysts and graphene for lithium ion batteries”. American Institute of Chemical Engineering Annual Meeting, Orlando, FL, 10-15 NOV19.
2. Manuscript in progress, “Electroless deposition of Noble Metal Nanoparticles onto Silk Fibroin Films”, (*to be submitted, Spring 2020)*

CH290: Modeling; Rheology of Blood
CH389/390: Fuel Cell Polymers
AIAD: ARL, Nickel Based Catalysts
CH490: Functionalized Graphene

Fourth Class | **Third Class** | **Second Class** | **First Class** | **Beyond**

CH290 | **CH389/CH390** | **CH489/CH490**

Future Signal Officer

<u>USMA Independent Research</u>

Cadet Dibiase has been working on a Proton Exchange Membrane (PEM) Fuel Cell project; a field of great interest for their efficiency advantages over combustion technology. However, conventional methods of electrolysis to produce H_2 and O_2 gas necessary for PEM fuel cells rely on expensive catalysts, Pt and IrO_2. Despite exceptional efficiency of these catalysts, their high costs prevent industry scale up and production. We present alternative Ni-based catalysts to replace Pt and IrO2. Of the Ni catalysts characterized, NiS and NiFe LDH together provided the smallest total overpotentials of 1.7 V (vs SHE) for Hydrogen Evolution Reactions (HER) and Oxygen Evolution reactions (OER), respectively. However, Linear Sweep Voltammetry illustrated that NiFe LDH had the lowest overpotential of the two, contributing only 0.3 V to the total overpotential. Nevertheless, the total overpotential of 1.7 V is still only 0.2 V above the industry standard of 1.5 V from a combination of Pt and IrO_2.

Future Faculty

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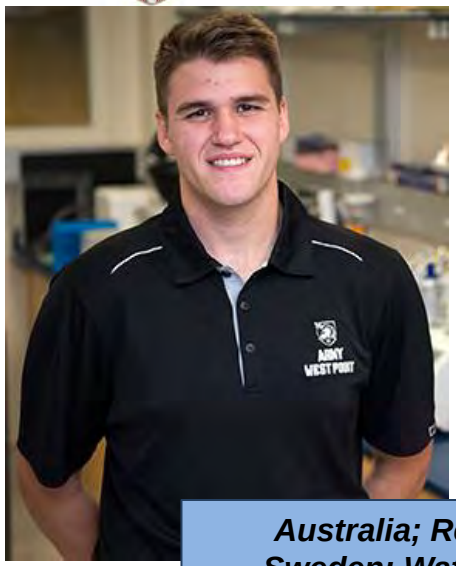
CDT Jesse Palmer, ’19
Chemical Engineering



- **Won Stamps Scholarship**
- **Won Goldwater Scholarship**
- **Tau Beta Pi Honor Society**
- **Phi Kappa Phi Honor Society**
- **Phi Sigma Iota Society**
- **Won Churchill Scholarship**

Co-Authored Publications

1. Cellulose Nanofiber Biotemplated Palladium Composite Aerogels. *Molecules,* 23(6)
2. Gelatin biotemplated platinum aerogels. *MRS Advances*, 1-6.
3. A Rapid Synthesis Method for Au, Pd, Aerogels Via direct Solution-Based Reduction. *Journal of visualized experiments: JoVE*, (136).
4. Direct solution-based reduction synthesis of Au, Pd, and Pt Aerogels. *Journal of Materials Research*, 32(22).

Australia; Renewable Energy Lab
Sweden: Water NEXUS conference

Harvard AIAD; Disease biophysics groups

Fourth Class → **Third Class** → **Second Class** → **First Class** → **Beyond**

CH290 → **CH389/CH390** → **CH489/CH490**

USMA Independent Research

Jesse has collaborated with the Army Research Labs (ARL) in Adelphi, MD to produce biosensors and has developed novel Kevlar-cellulose composites with Harvard’s Disease Biophysics group. As a recipient of Goldwater and Stamps Scholarships Jesse has used his academic funding to attend World Water Week in Stockholm, Sweden and visit the University of New South Wales in Sydney, Australia to pursue his interest in water desalination. Jesse is also completing a minor in Eurasian Studies. He plans on attending graduate school to develop batteries to enhance prosthetic limbs serving wounded veterans.

Field Artillery Officer

Future Faculty

Engineering Concentrations

Pre-approved elective sequences,
but ultimately cadet choice (can choose any 3)

Materials Engineering
MC364 Mechanics of Materials
MC380 Engineering Materials
Open Elective

Nuclear Engineering
NE300 Nuclear Reactor Analysis
NE350 Nuclear Reactor Design
NE450 Nuclear Systems Design

Decision Analysis
SE301 Foundations of Engineering Design & Systems Management
SE 481 Systems Simulation
EM484 Dynamic Systems Analysis

Advanced Control Systems
EE360 Digital Computer Logic
EM484 Dynamic Systems Analysis
XE475 Mechatronics

Energy Conversion Systems
EE377 Electrical Power Generation
ME472 Energy Conversion Systems
ME480 Heat Transfer

Power Systems
ME306 Dynamics
ME491 Mechanical Power Plants
EE377 Electrical Power Generation
XE442 Alternative Energy Engineering

Industrial Engineering
SE301 Foundations of Engineering Design & Systems Management
EM411 Project Management
EM420 Production Operations Management

Other Advanced Engineering Electives
Satisfy prerequisites
Engineering Science or design = 3.0 credits
Program director approval

Some Administrative

- Next Advisory Board on-site
  - Late April/Early May 2022…close out Class of ‘21
- Travel Paperwork/Dinner settle
- Tour of Unit Operations Lab…UTC

End of Section 4

Chemical Engineering

Advisory Board Meeting

23 April 2021

Thank you!

United States Military Academy
Department of Chemistry and Life Science

Back Up Slides