



Chemical Engineering

United States Military Academy



Advisory Board Meeting

26 April 2019

United States Military Academy
Department of Chemistry and Life Science

Advisory Board Meeting Agenda

26 April 2019

Date	Time	Event	Location	OIC
25APR19	NLT1700	Pick up 15 PAX van	Motorpool	LTC April Miller
	1830 - UTC	Dinner	Barnstormer BBQ Fort Montgomery, NY (845) 446 -0912	LTC Armstrong
26APR19	0730	Pick up	Holiday Inn Express Montgomery Falls, NY (845) 446 - 4277	
	0745 - 0800	Arrival and lite breakfast	BH465 (table side)	LTC Armstrong LTC James
	0800 - 0830	Session1: Introductory remarks and ABET orientation	BH465	DEPT Head LTC Armstrong
	0830 - 0920	Session2: Program Assessment Student Outcomes Assessment Discussion of Program Objectives	BH465	
	0920 - 0935	Board Surveys	BH465	LTC Armstrong
	0935-0950	Session3: CH367 Update		
	1000 - 1050	Career Panel	BH465 (chair side)	LTC Armstrong
	1050 - 1115	Cadet Discussions	BH465 (chair side)	
	1130 - 1300	Lunch/Firstie Mock Interview Round Robi	BH465	Dr. Biaglow
	1300 - 1330	Board backbrief on cadet interactions	BH465	LTC Armstrong
				LTC James
	1340 - 1430	Session 4: Future Challenges	BH465	LTC Armstrong
	1430 - 1455	Admin and Unit Ops Lab Tour	SBBH	LTC Armstrong
				LTC James
	1500 - 1530	Wrap up	BH465	



Lunch – Subs and Wraps in BH465



- 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

United States Military Academy



Advisory Board Meeting

26 April 2019

1. Introductory Remarks

United States Military Academy
Department of Chemistry and Life Science

Thank You! Advisory Board 2018-2019

Dr. Lynn Walker Professor of Chemical Engineering Carnegie Mellon University Doherty Hall, 5000 Forbes Avenue Pittsburgh, PA 15213 (412) 268 - 3020 lwalker@andrew.cmu.edu	Kisondra Waters Principal Analyst, Competitive Cost & Margin Analytics, HIS Chemical 1 N Lexington Ave, 17th Floor White Plains, NY 10601 (650) 714-1751 kisondra@gmail.com	Donald C. Glaser President, Simulation Solutions, Inc. 179 Avenue at the Common Shrewsbury, NJ 07702 (732)-389-5400 dglaser@simulation-solutions.com
COL (Ret) Paul Dietrich 3855 Victory Blvd Staten Island, NY 10314-6716 (718) 698-8526 paul@the-dietrichs.com	Matt Garvey Simulation Solutions, Inc. Shrewsbury, NJ (732)-389-5400 mgarvey@simulation-solutions.com	Dr. Patrick Underhill Associate Professor, Chemical Engineering Rensselaer Polytechnic Institute Ricketts Building Troy, NY 12180 (518) 276-3032 underhill@rpi.edu
Dr. Matthew Liberatore Professor of Chemical Engineering University of Toledo 3055 Nitschke Hall, 2801 W Bancroft St Toledo, OH 43606 (419) 530-8267 matthew.liberatore@utoledo.edu	Dr. Kelly Schultz Assistant Professor Lehigh University Ilococca Hall, 111 Research Drive Bethlehem, PA 18015 (610) 758-2012 kes513@lehigh.edu	LTC Margaret Nowicki Academy Professor United States Military Academy Civil and Mechanical Engineering West Point, NY 10996 (845) 938 - 0635 Margaret.nowicki@westpoint.edu
Mike Deforest USMA Class of '07, Chemical Engineer SMK Packaging (619) 735 - 5300 mike@smkpackaging.com	Patrick Nonhof Managing Partner Provenance Consulting (610) 758-2012 Patrick.Nonhof@provenanceconsulting.com	

Advisory Board Bench

Kevin Shipe Automation Innovation Engineer NALCO Champion 7705 Hwy 90A, Sugarland, TX 77498 281-263-7335 kevin.a.shipe@gmail.com	Lucy Hair EleCent Team Leader CPOIS Program Lawrence Livermore National Lab 925-423-8545 hair1@llnl.gov	Anthony Hatfield Eli Lilly and Company Consultant Engineer Indianapolis Parenteral Man. Cartridge Facility 317-655-0429 hatfieldan@lilly.com
COL (Ret) Vance P. (Phil) Visser 2925 Thomas Smith Lane Williamsburg, VA 23185 757-254-3017 philvisser@yahoo.com	COL (Ret) Dwight Springer Former Deputy Head Chemistry and Life Science US Military Academy 817-431-5331 dss5456@verizon.net	

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





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
West Point is the preeminent leader
whose graduates thrive in tomorrow's
development institution in the world.
complex security environments,
and are inspired to a lifetime of service to
our Army and the Nation as leaders of
character.**

"Inspired to serve."



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.



Engineering Technology Accreditation Commission



Accredited 1 October 2012 to present

Next Record Year: AY2019-2020

Next ABET Visit: Fall 2020

Why ABET Accreditation?

- An external certification of quality
- Keeps us in touch with the engineering profession
- Helps USMA (and ChemE) recruiting (classes of 2019 and 2020, 30+ plebes, 2021 - 26; 100 total – a new high)
- 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

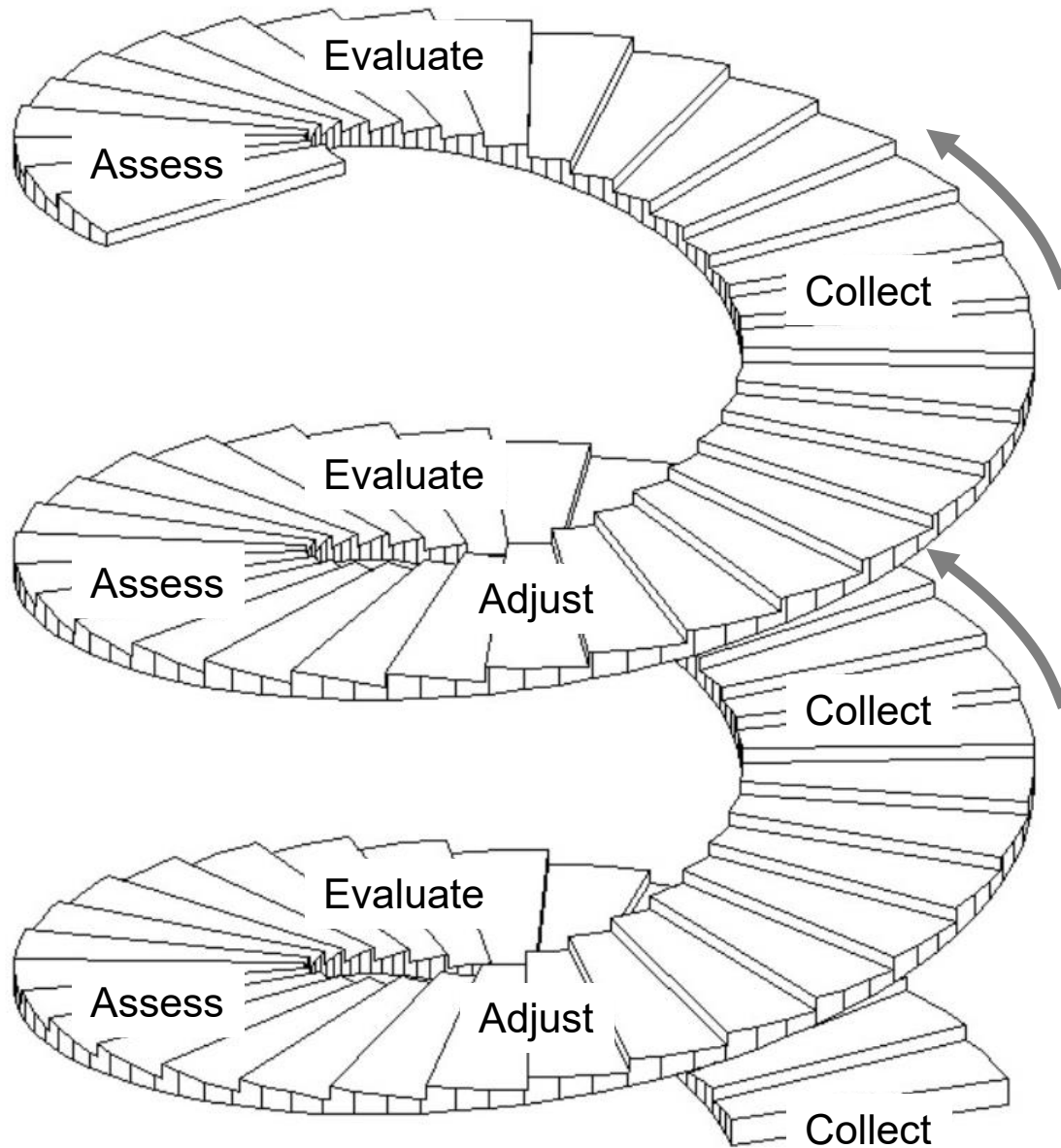
- The ABET process is expensive in terms of faculty time
 - USMA is a small undergraduate college with limited human resources (faculty) and high faculty turnover
- The ABET accreditation is important to the institution and to the Army (so we tend to do it well)
- The only way we can be successful with 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

Terms You Should Know

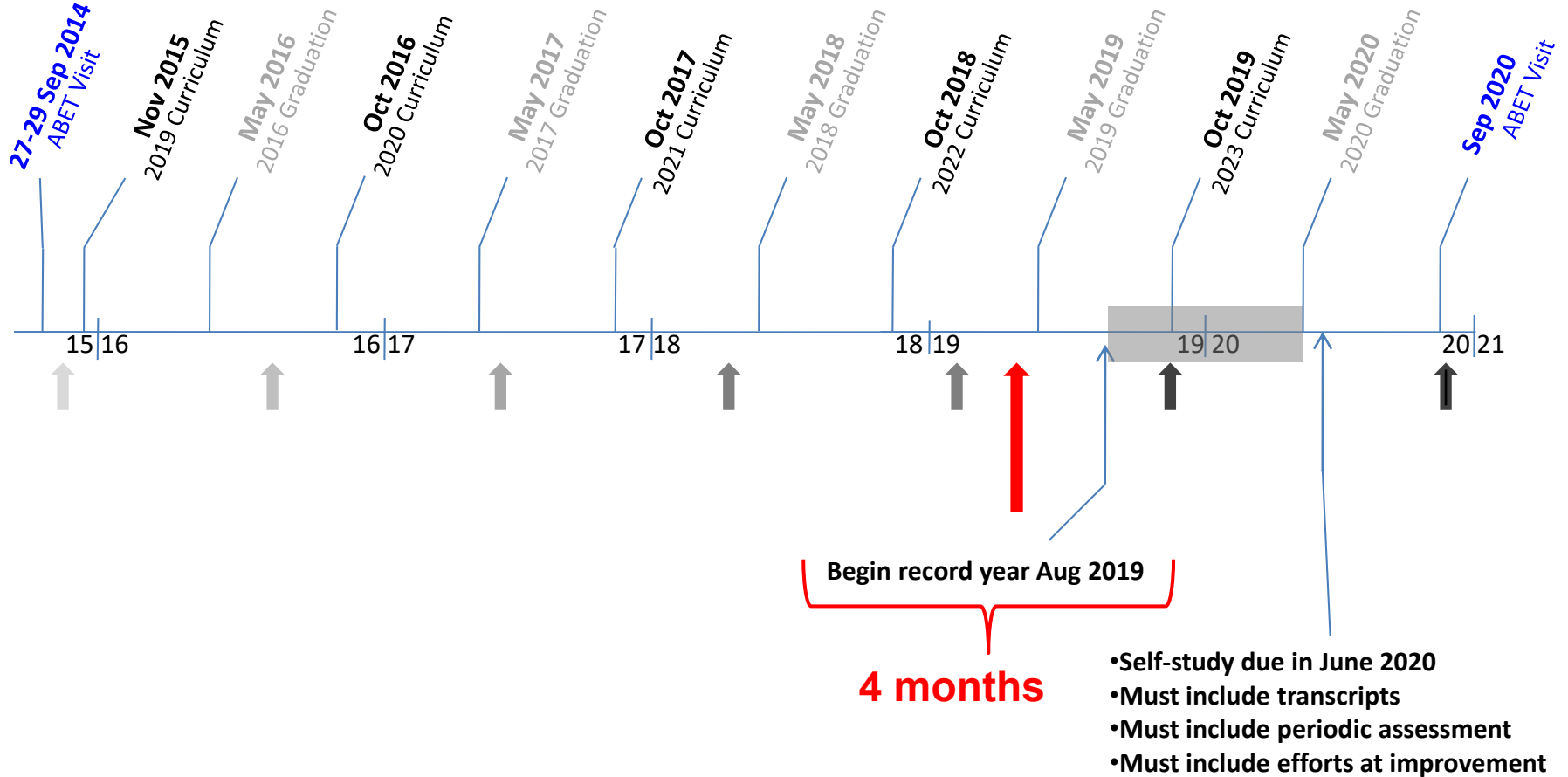
- **Program Educational Objectives (PEOs)**
 - Gleaned by asking *program constituents*
 - For us: Army, profession, graduate schools, other
 - **Our external Advisory Board a key resource.**
 - Desired professional accomplishments of graduates **5-7 years after graduation**
 - Adjust every 3 years or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



Timeline for Curricular Actions



Advisory Board Findings

Excerpts from Minutes of 4 May 2018

- CH400 professional practice was discussed at length with cadet panel; and faculty; overall stay on current azimuth
- AIAD length discussion
- 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
- CH400 split between positive and negative feedback
- 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

United States Military Academy



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2. Program Assessment

United States Military Academy
Department of Chemistry and Life Science

Student Outcomes (old used for AY18)

Identical to ABET a-k as described on slide 11

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

1. Apply knowledge of mathematics, science, and engineering.
2. Design and conduct experiments, as well as analyze and interpret data.
3. Design a system, component, or process to meet desired needs within economic, environmental, social, political, ethical, health and safety, manufacturing, and sustainability constraints.
4. Function on multidisciplinary teams.
5. Identify, formulate, and solve engineering problems.
6. Understand professional and ethical responsibilities.
7. Communicate effectively.
8. Understand the impact of engineering solutions in a global economic, environmental, and societal context.
9. Recognize the need and develop the skills required for life-long learning.
10. Demonstrate knowledge of contemporary issues.
11. Demonstrate an ability to use techniques, skills, and modern engineering tools necessary for engineering practice.

Student Outcomes (old used for AY18)

Additional outcomes articulated by the program as described on slide 11

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

- a. General, organic, and physical chemistry.
- b. Material and energy balances on chemical processes, including safety and environmental factors.
- c. Thermodynamics of physical and chemical equilibria.
- d. Heat, mass, and momentum transfer.
- e. Chemical reaction engineering.
- f. Continuous and staged separation operations.
- g. Process dynamics and control.
- h. Modern experimental and computing techniques.
- i. Process design.

Student Outcomes (new used for AY19)

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

Assessment

CHEME Coursework Embedded Indicators

MECHE Coursework Embedded Indicators

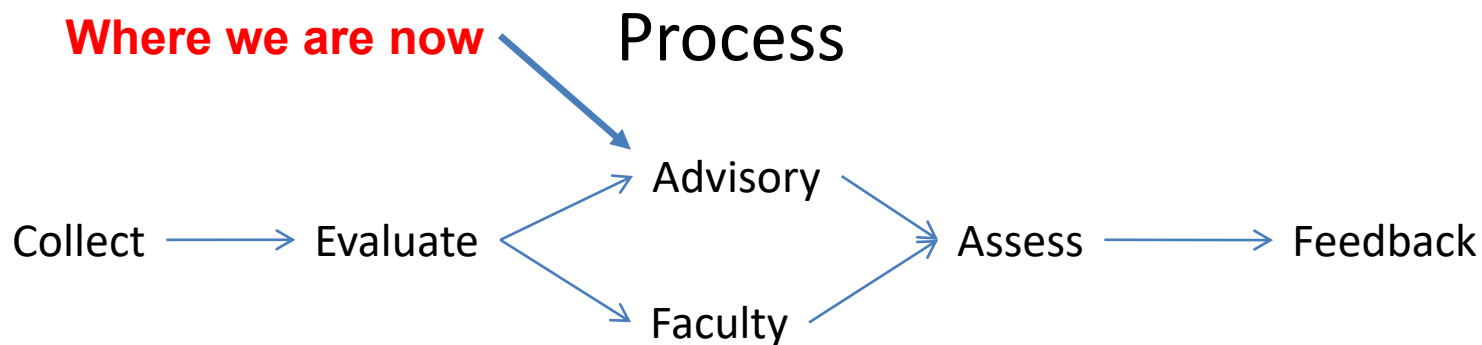
Fundamentals of Engineering Exam Topics

Participation in FE Exam (not pass rate)

Student end of semester surveys

Student CHEME Program Exit Surveys

Course Grades





Chemical Engineering



United States Military Academy



Example Schedule for Chemical Engineering, Classes of 2021 and Beyond

Fall Term	Course	Credit Hours	Spring Term	Course	Credit Hours
4th CLASS					
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	MA364/5	Engineering Mathematics	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 I	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

Current Curriculum

CEN1 - Class of 2021

4th Class Year Fall Term	Spring Term	3rd Class Year Fall Term	Spring Term	2nd Class Year Fall Term	Spring Term	1st Class Year Fall Term	Spring Term
<i>E</i> MA103 4.0	<i>E</i> MA104 4.5	<i>E</i> MA205 4.5	<i>R</i> CH362 3.5	<i>R</i> EE301 3.5	<i>D</i> MC300 3.0	<i>D,R</i> CH459 3.5	CH402 3.0
<i>/D</i> EV203/ CH101 4.0	<i>D/R</i> CH101/ PH205 4.0	<i>R</i> PH205/ PH206 4.0	<i>R/</i> PH206/ EV203 4.0	<i>R</i> CH363 3.5	<i>R</i> CH364 3.5	CH365 3.0	CH400 1.5
EN101 3.0	EN102 3.0	<i>R</i> CH102 4	MA364/5 3.0	<i>R</i> CH383 3.5	MC312 3.0	<i>R</i> CH485 3.5	Engr Elective 3.0
IT105 3.0	PL100 3.0	<i>E</i> DFL1 4.0	PY201 3.0	<i>D</i> MC311 3.5	CH367 3.0	Engr Elective 3.0	<i>D</i> LW403 3.5
HI105 3.0	HI108 3.0	<i>R</i> SS201 3.5	<i>E</i> DFL2 4.0	MA206 3.0	SS307 3.0	Engr Elective 3.0	<i>R</i> HI302 3.0
			<i>R</i> SS202 3.5	PL300 3.0			MX400 3.0

We began the major with 5 chemical engineering courses taught in the department.

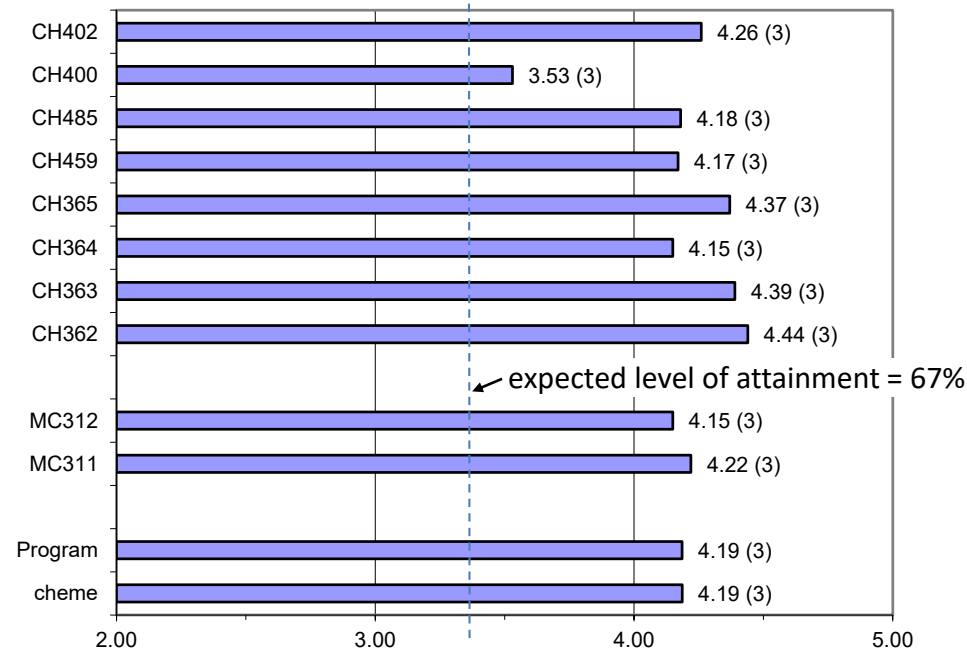
With advisory board support, we now have **nine**.

Example Data: Coursework Embedded Indicators

Slide Updated
27 July 2018

Student Outcome 1

Ability to apply knowledge of mathematics, science, and engineering.



Values in parentheses are coverage ratings from Table 5-3 in the Self Study, page 5-9

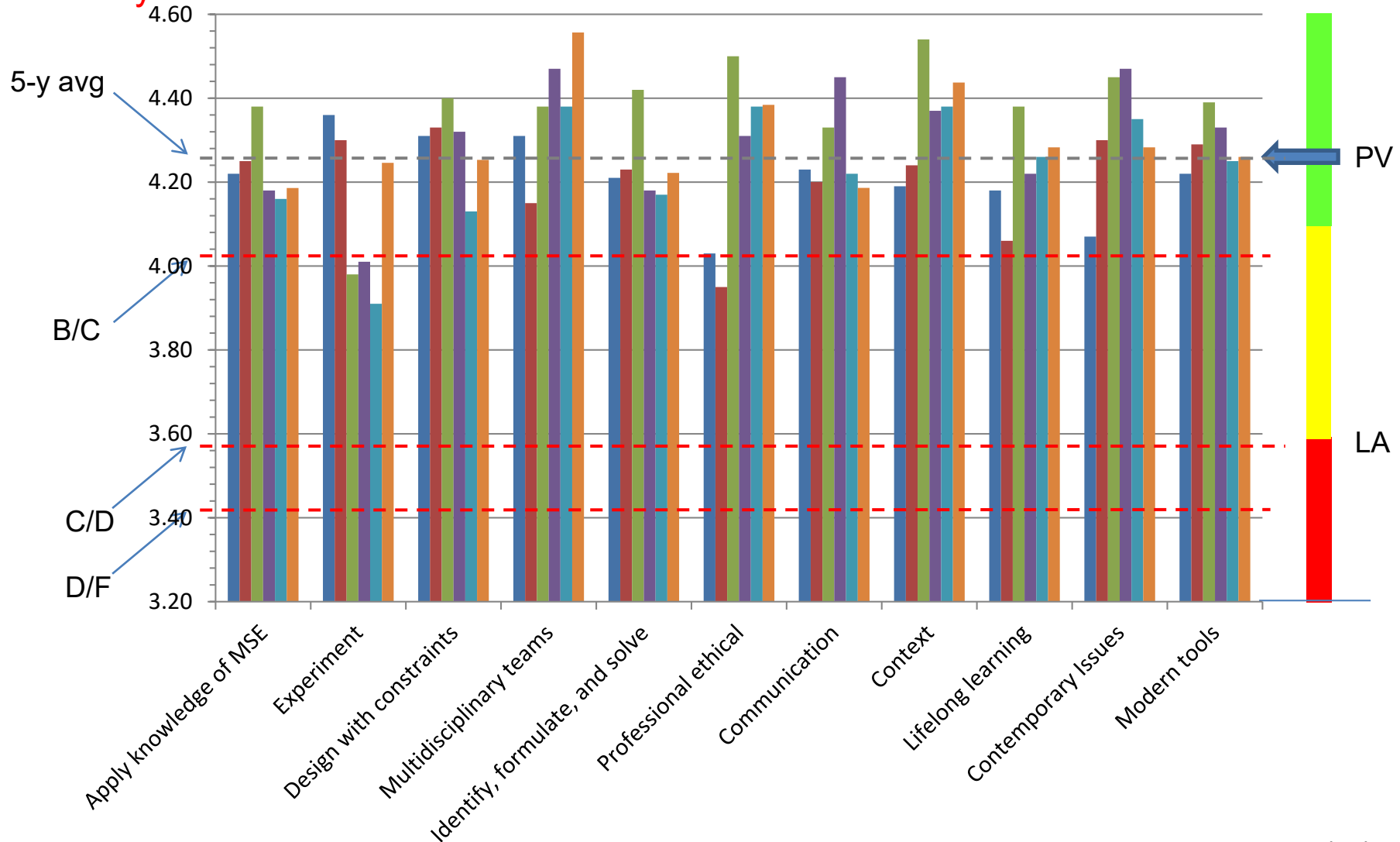
Data shown here is for Class of 2018
Similar data is collected for all 11 ABET outcomes
Summary of all data is shown on next slide
(AY18 is assessed using old outcomes)

Performance on Embedded Indicators

Program Averages AY2013 to AY2018

Slide Updated
27 July 2018

■ 2013 ■ 2014 ■ 2015 ■ 2016 ■ 2017 ■ 2018



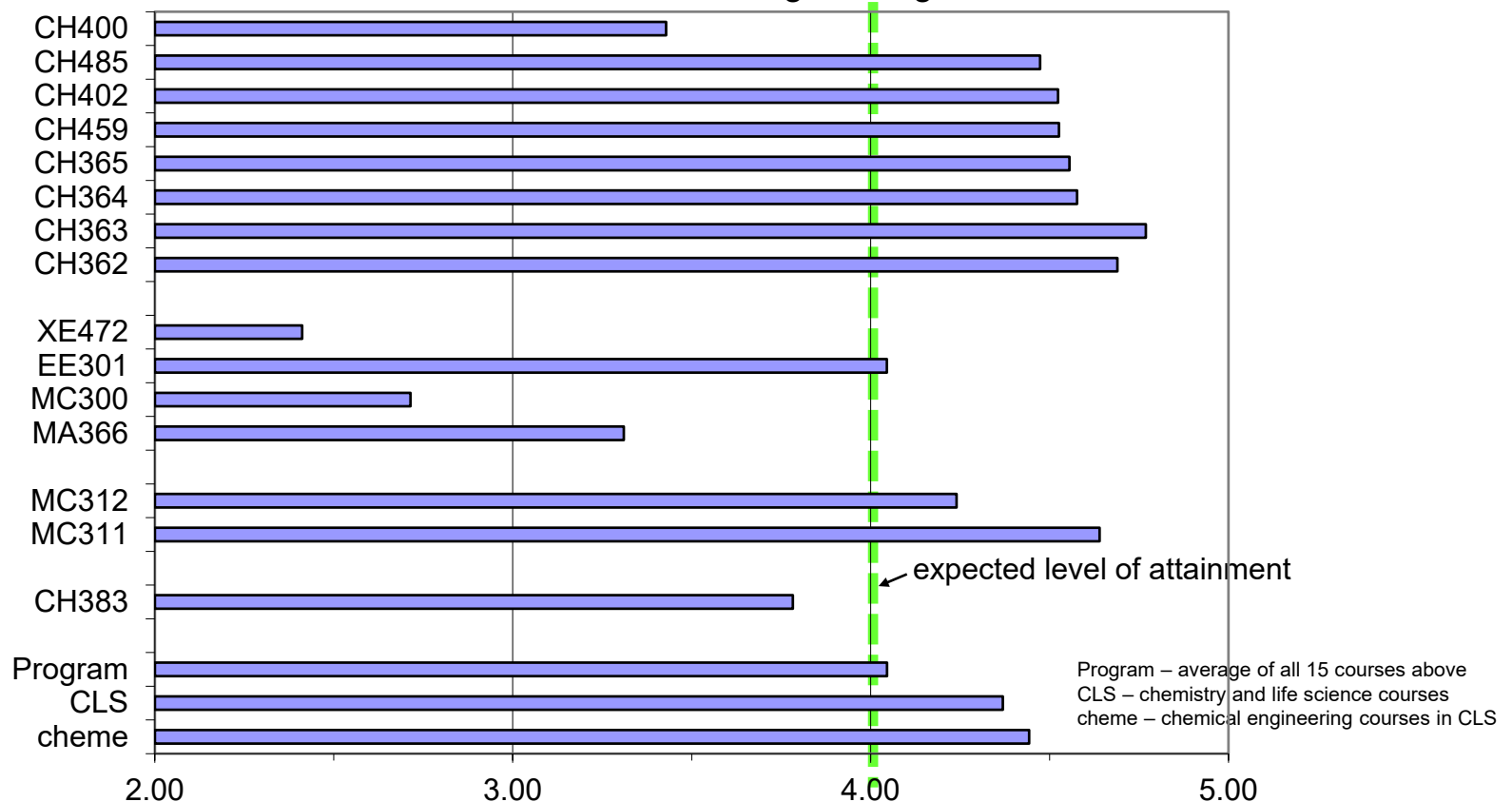
expected level of attainment is the 5-year average (PV)

Example Data: End-of-Semester Surveys

Student Outcome 1

Slide Updated
27 July 2018

This course has improved my ability to apply knowledge of mathematics, science, and engineering.

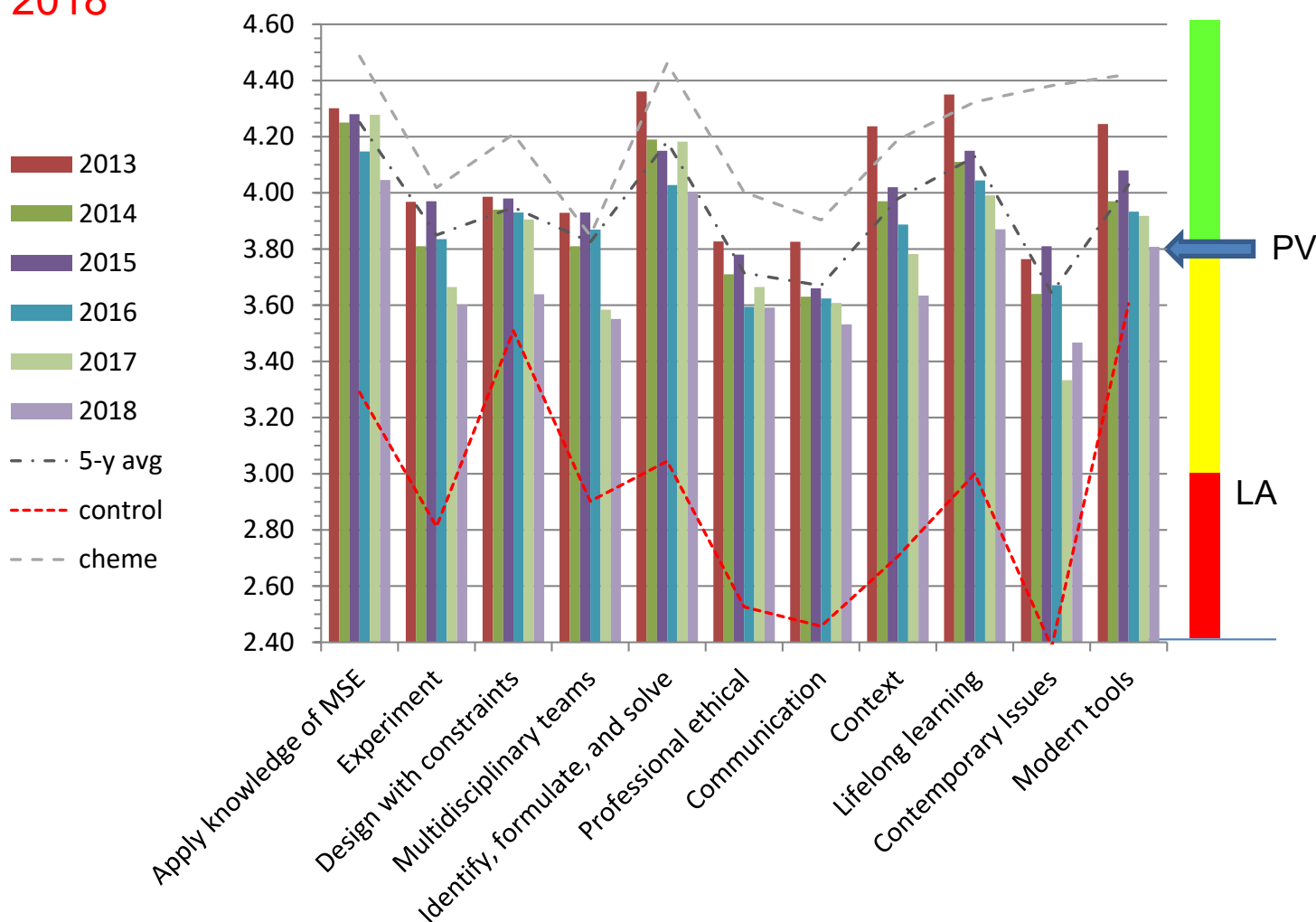


Data shown here is for Class of 2018
Similar data is collected for all 11 ABET outcomes (old)
Summary of all data is shown on next slide

End-of-Semester Surveys

Normalized Program Averages from AY13-18

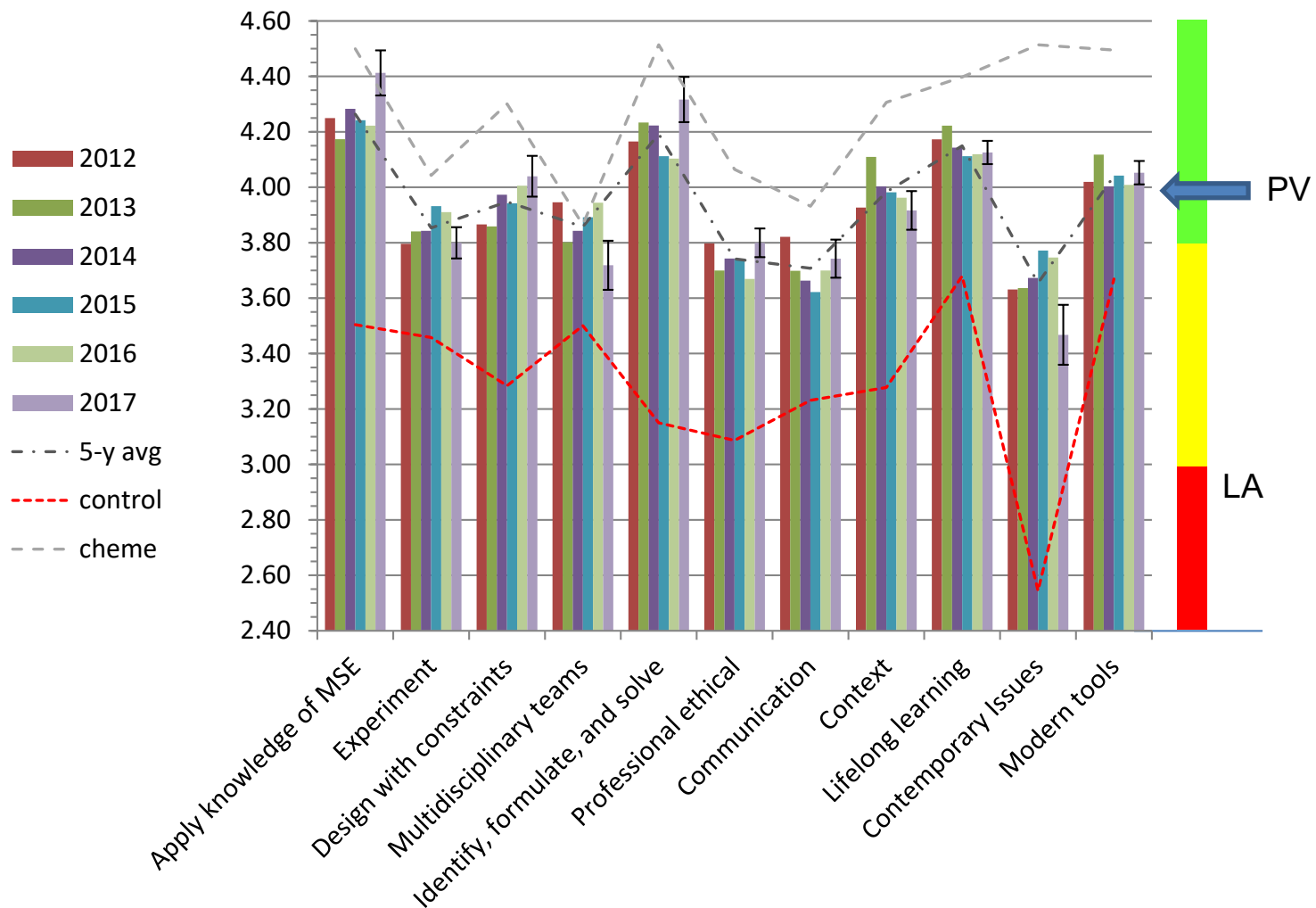
Slide Updated
27 July 2018



expected level of attainment is the 5-year average (PV)

End-of-Semester Surveys

Normalized Program Averages from AY12-17



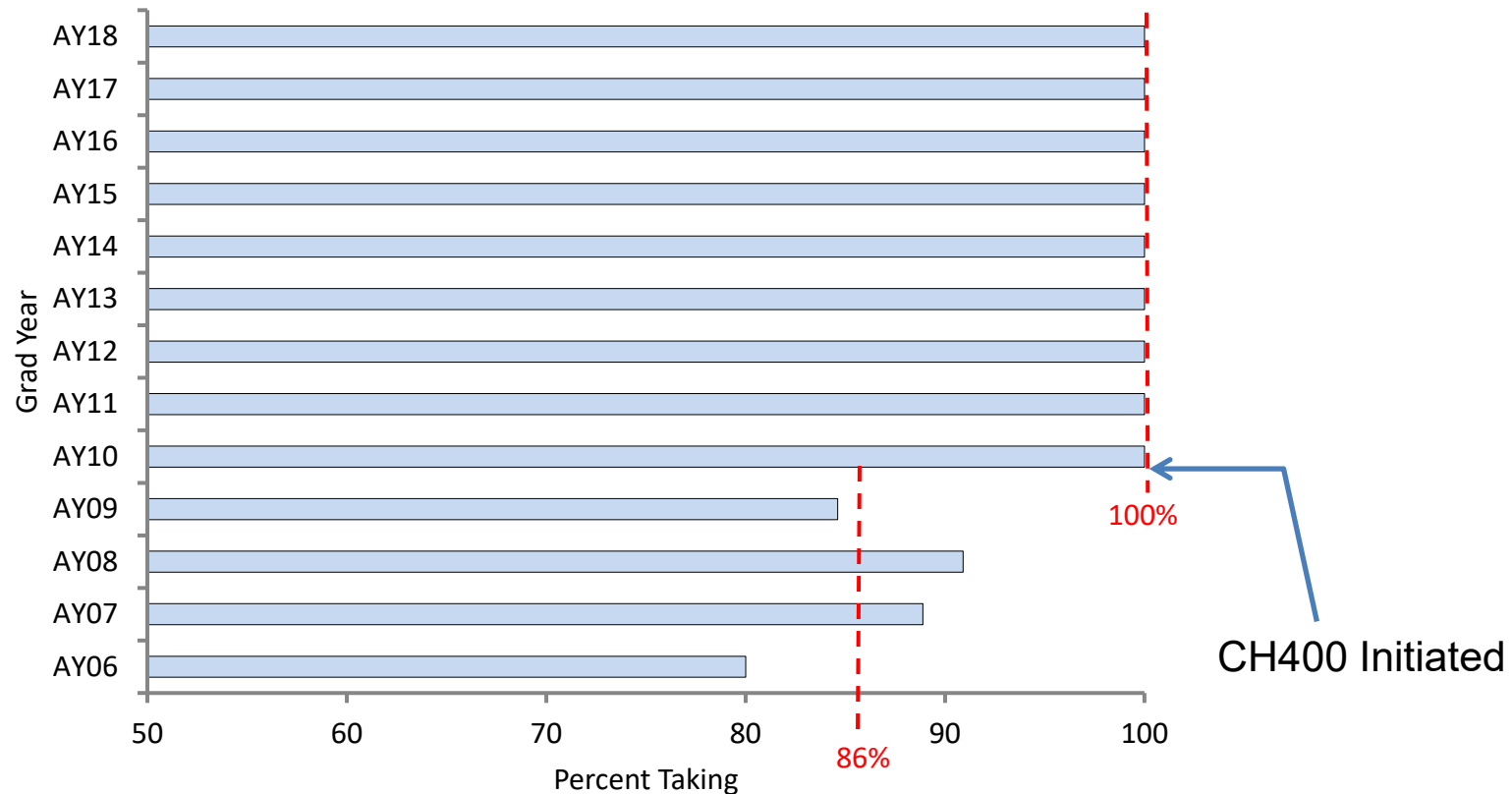
expected level of attainment is the 5-year average (PV)

Fundamentals of Engineering Exam

Outcome 9: Recognizing the Need and Develop the Skills for Life-long Learning

Slide Updated
27 July 2018

Percent of cadets taking the FE Exam

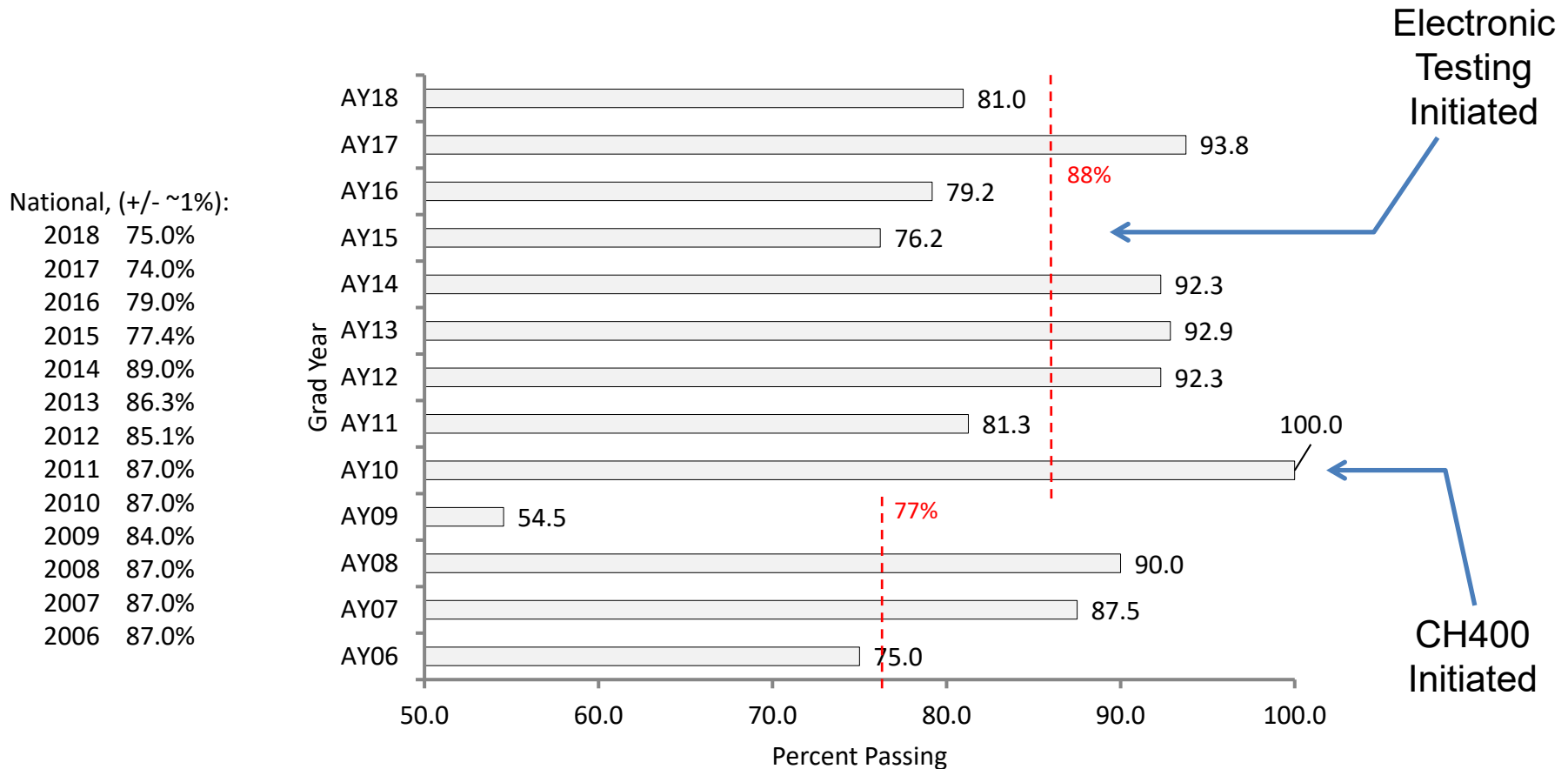


Fundamentals of Engineering Exam

Outcome 9: Recognizing the Need and Develop the Skills for Life-long Learning

Percent of cadets passing the FE Exam

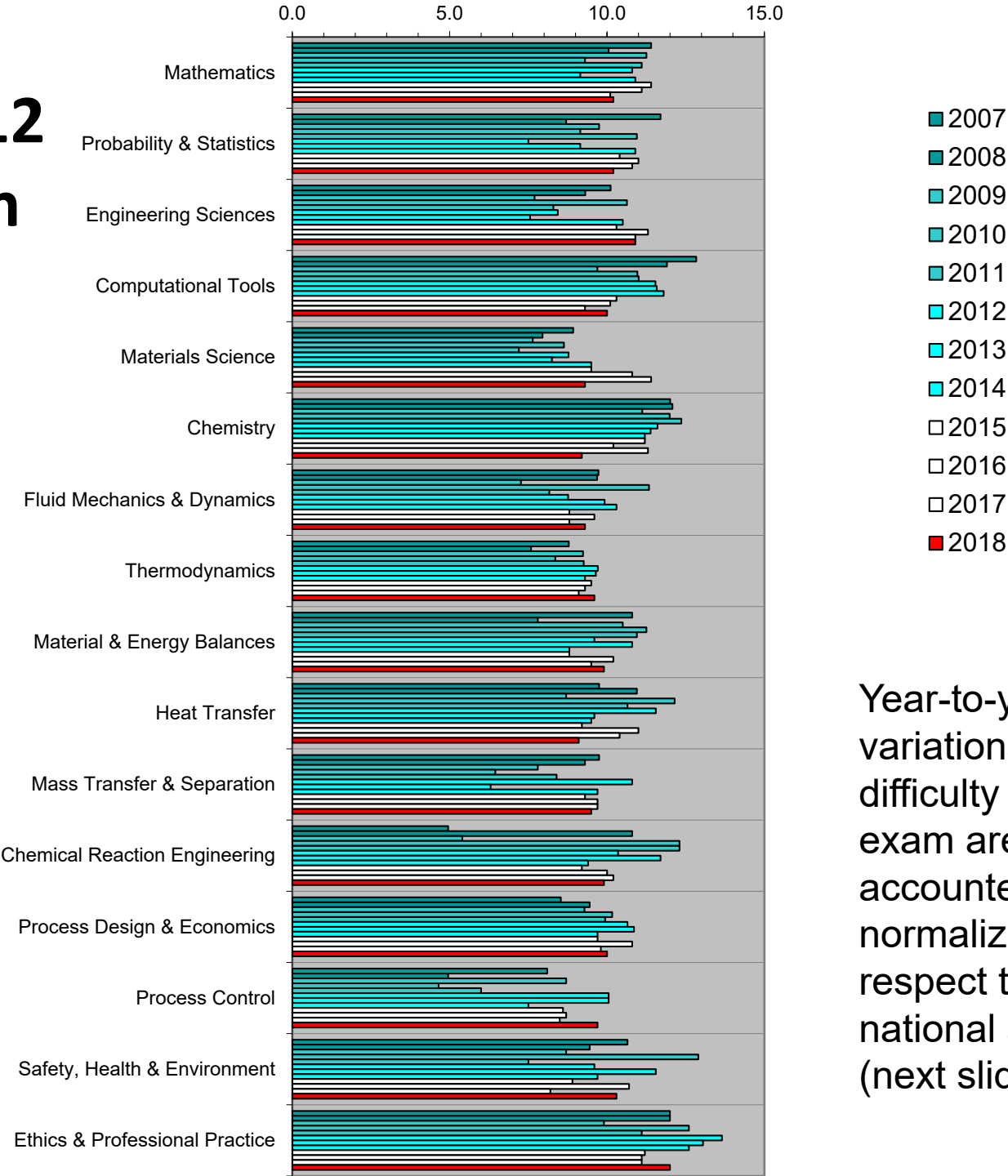
Slide Updated
27 July 2018



Outcome 12 Evaluation

FEE Results
by Topic

AY07 to AY18

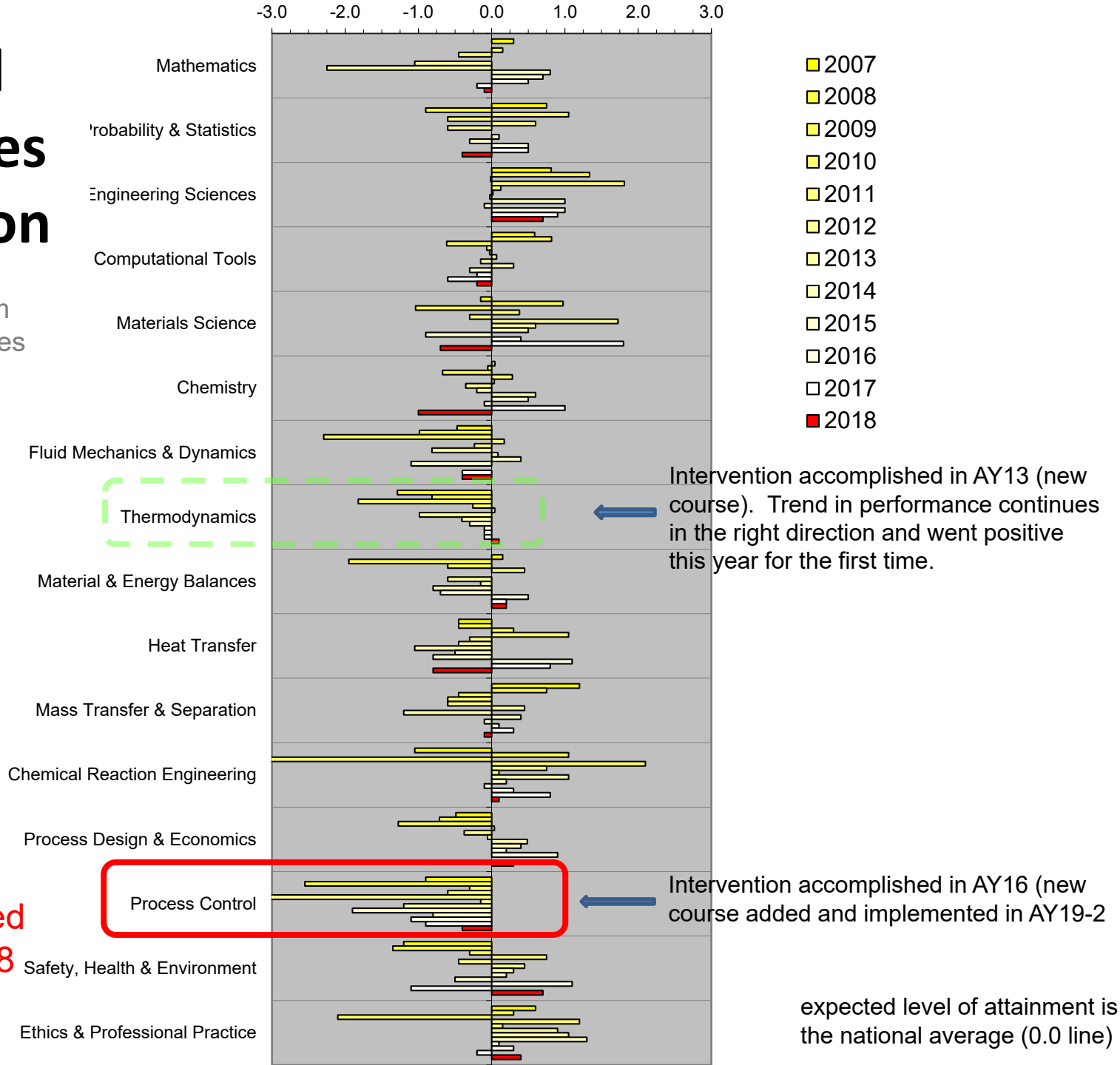


Year-to-year variations in the difficulty of the exam are accounted for by normalizing with respect to the national average (next slide).

Slide Updated
27 July 2018

Topical Outcomes Evaluation

Deviations from
National Averages
AY07 to AY18

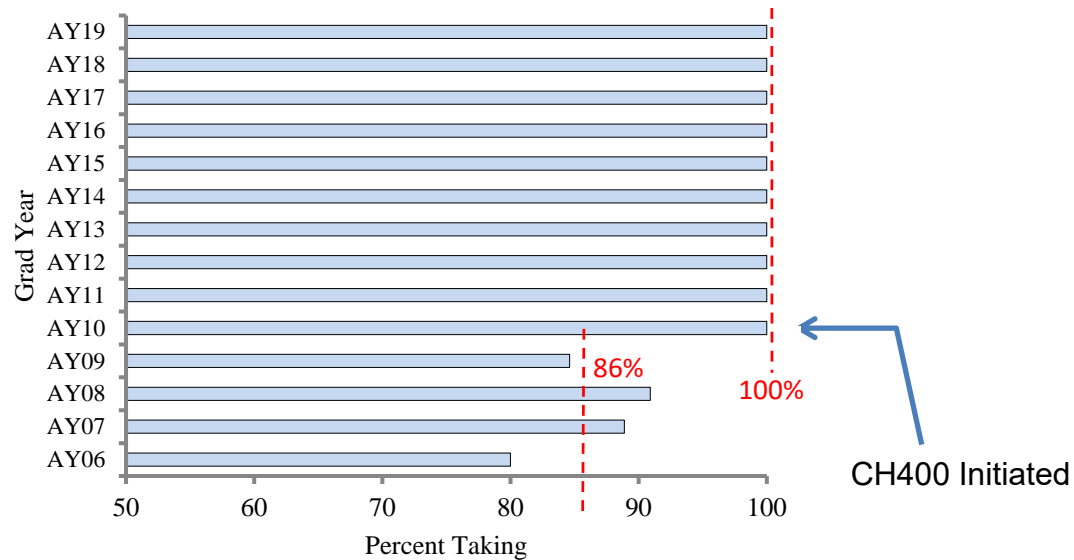


Slide Updated
27 July 2018

Fundamentals of Engineering Exam

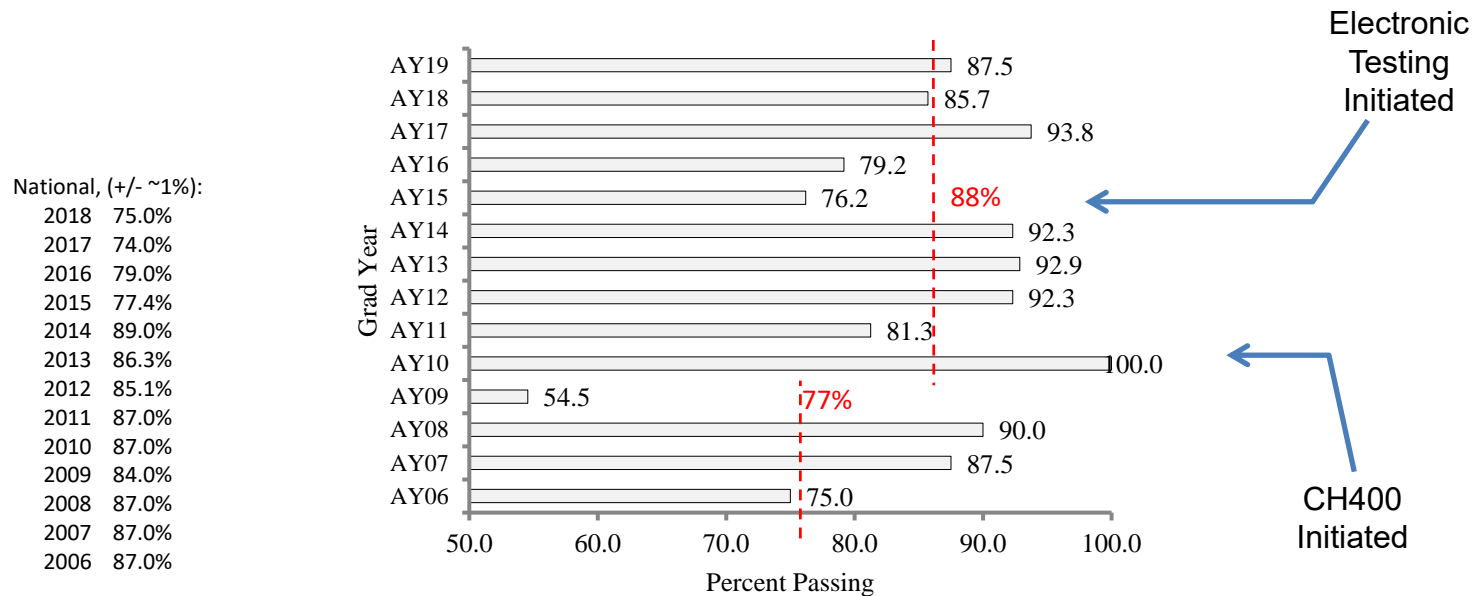
Slide Updated 4 April 2019

Percent of cadets taking the FE Exam



Fundamentals of Engineering Exam

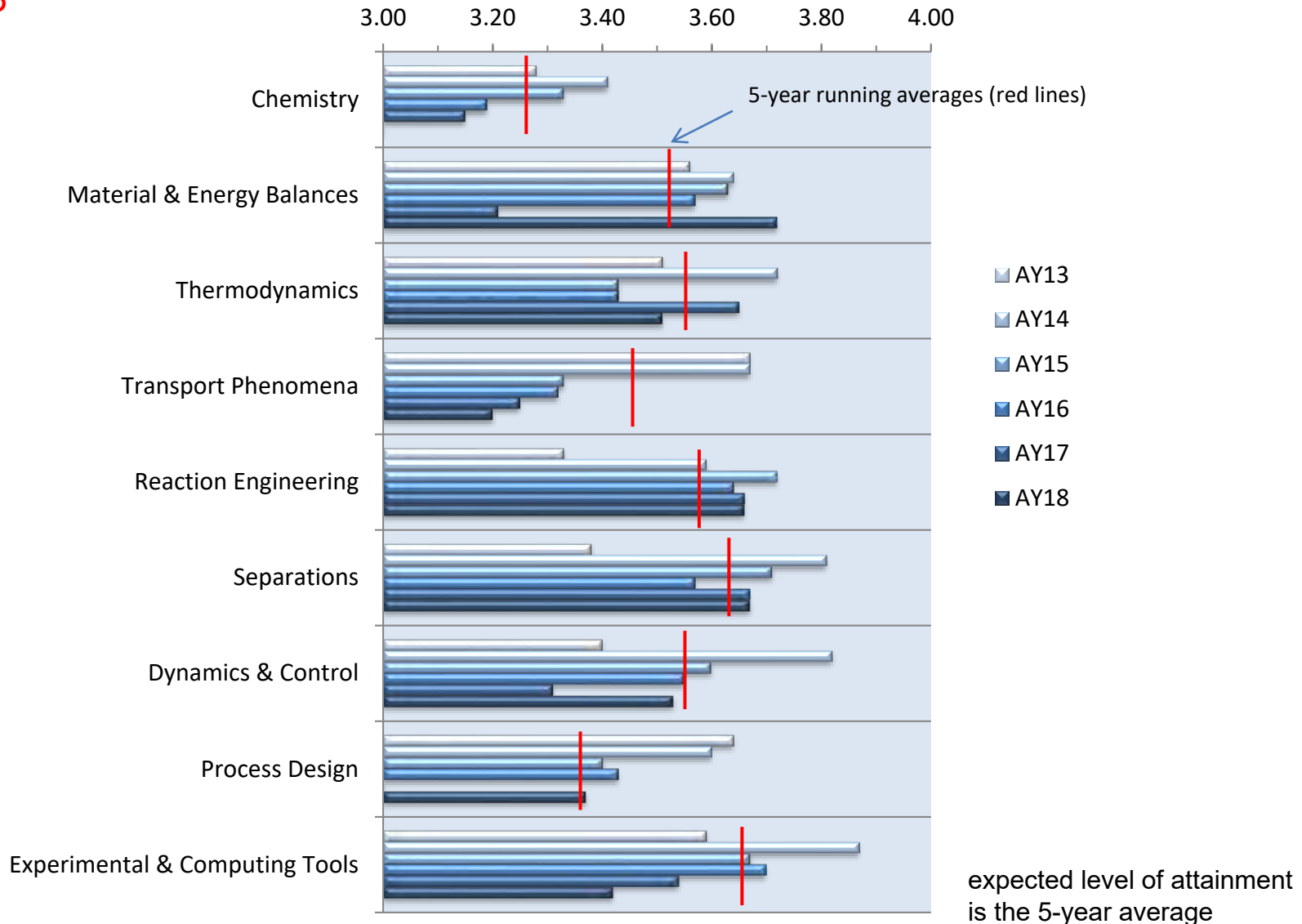
Slide Updated 4 April 2019 Percent of cadets passing the FE Exam



Topical Outcomes Evaluation

Average Course GPA from Transcripts, AY2012 to AY2017

Slide Updated
27 July 2018



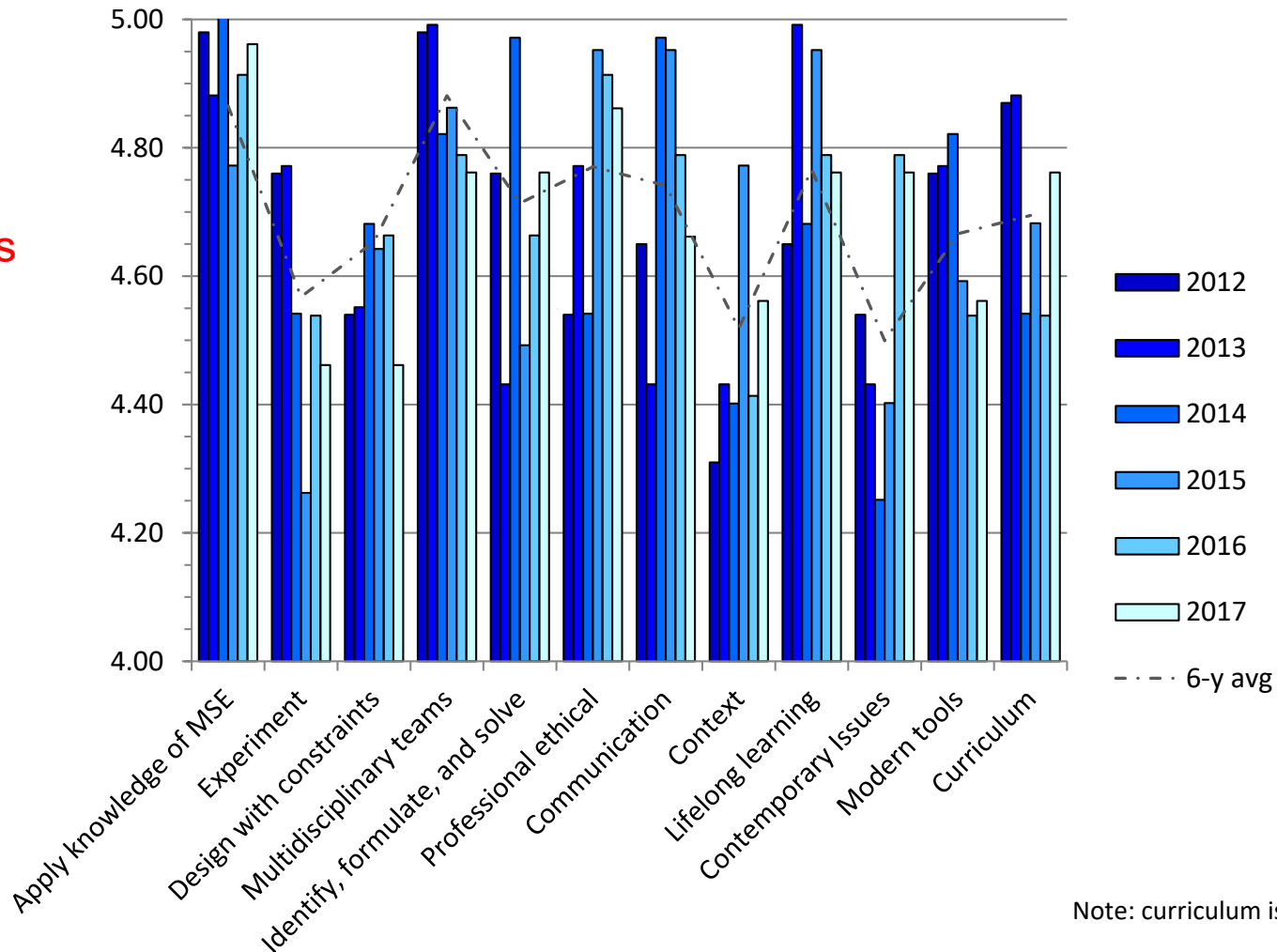
Advisory Board Student Outcomes Surveys

Normalized Program Averages from AY12-17

Slide Updated
4 May 2018
after last
meeting

(AB updates
responses this
meeting)

Data are normalized to compensate your year-to-year fluctuations in the survey average.



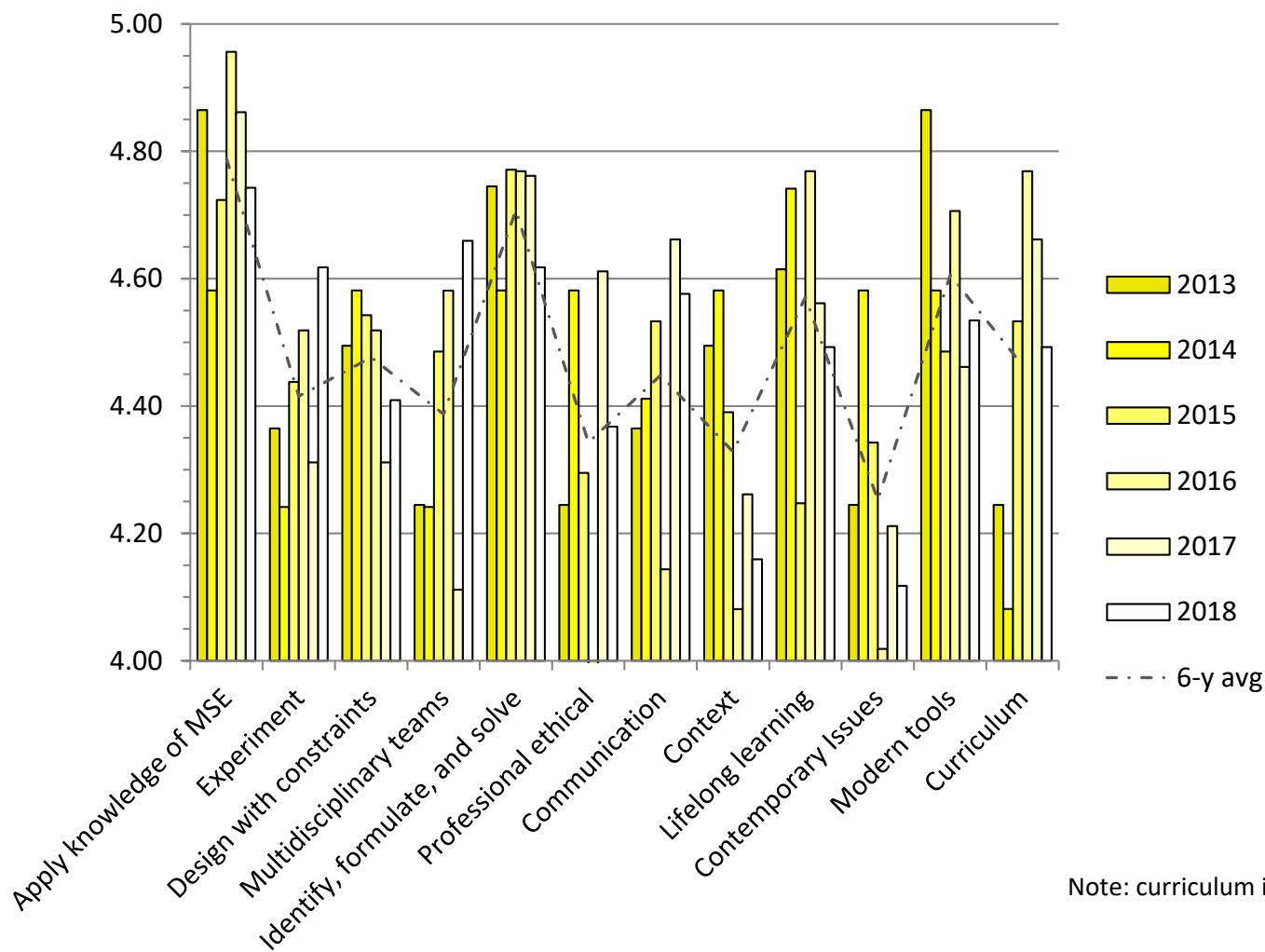
Note: curriculum is outcome 12

Faculty Student Outcomes Surveys

Normalized Program Averages from AY13-18

Slide Updated
12 Oct 2018

Data are normalized to compensate your year-to-year fluctuations in the survey average.

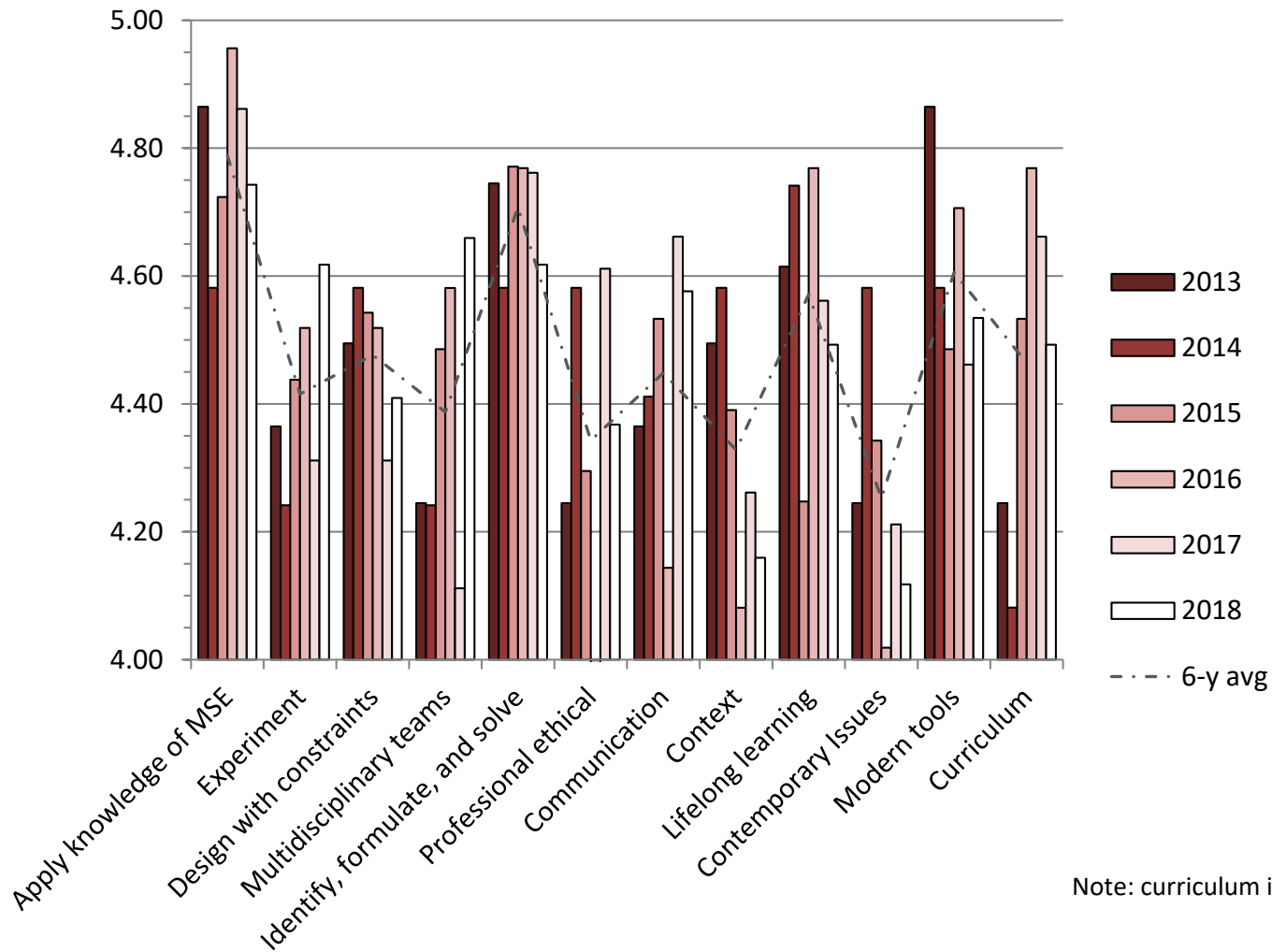


Cadet Student Outcomes Surveys

Normalized Program Averages from AY13-18

Slide Updated
15 Jan 2019

Data are normalized to compensate your year-to-year fluctuations in the survey average.





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.

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

Strategy going forward:

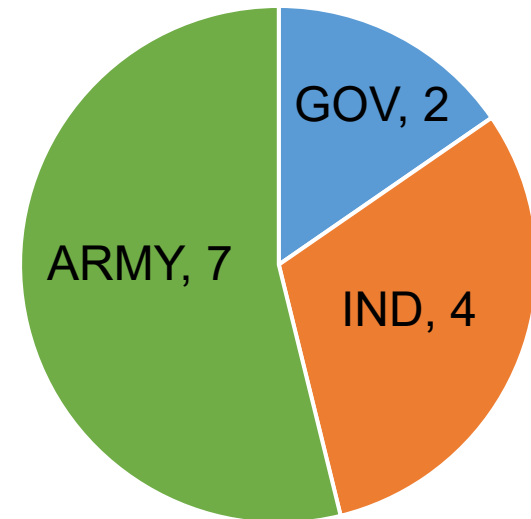
Assess consistency with the mission of the institution and the needs of the constituencies improve objectives.

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



13 fully funded internships
16+ available



Advisory Board Completes Survey Part 2



Chemical Engineering

United States Military Academy



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26 April 2019

3. Update for CH367 Automatic Process Control

United States Military Academy
Department of Chemistry and Life Science

CH367

Introduction to Automatic Process Control

CH367 (Version: 2020 2) COURSE DETAILS

COURSE	TITLE	EFF YEAR	EFF TERM	CREDIT HOURS
CH367	INTRO TO AUTOMATIC PROCESS CONTROL	2020	2	3.0 (BS=0.0, ET=3.0, MA=0.0)

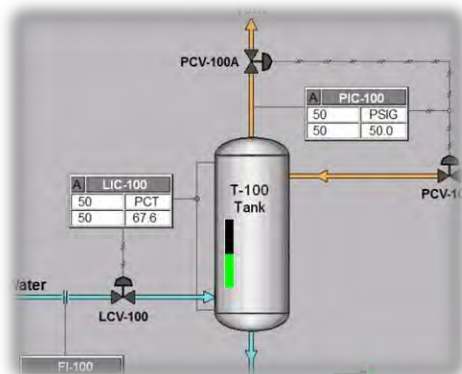
SCOPE

This course covers the principles necessary to understand the automatic control of chemical processes. Students learn the current mathematical models and mechanical details of various control elements, including sensors, transmitters, actuators, and controllers. Application of mathematical models will be covered with dynamic modeling techniques as well as real-time training using process simulators. The course will also cover tuning of controllers as well as safe response to process upsets. A capstone project will involve dynamic modelling of an integrated process control system.

LESSONS: 40 @ 55 min (3.000 Att/wk) **LABS:** 0 @ 120 min

First iteration: AY 2019-2 (Spring 2019) for class of 2020

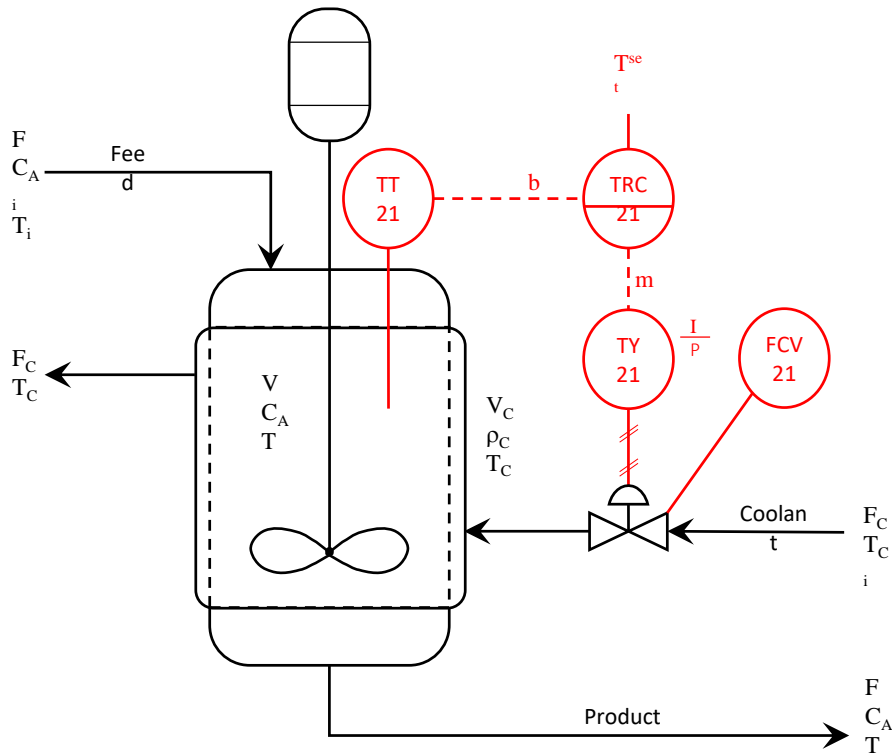
Text: Process Dynamics and Control, Seborg, et al.



- Dynamic behavior of chemical processes
- Stability
- Tuning
- Relating block diagrams to P&IDs
- Multi-loop interactions



CH367 Capstone



Objectives

- Write a descriptive interpretation of each element in a control loop.
- Linearization of model equations and developing transfer functions.
- Draw a complete block diagram for an actual control loop.
- Design and implement a PI controller for a chemical reactor, and implement a numerical solution to the equations that describe the process dynamics.
- Tune a controller.



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



Board – Cadet Discussions



Concept (flexible) of discussions

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Lunch – Subs and Wraps in BH465



- 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



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Advisory Board Meeting

26 April 2019

4. Future Challenges

United States Military Academy
Department of Chemistry and Life Science

Academic Excellence



- #1 Most Accessible Professors**
- #2 Best College Library**



- #1 Public College in the country**
- #6 Liberal Arts Universities**
- #11 In the Northeast**
- #14 Overall College in the country**



- #2 Top Public Schools (Liberal Arts)**
- #3 Best Undergrad Engineering Program**
- #4 Civil Engineering Program**
- #7 Mechanical Engineering Program**
- #19 National Liberal Arts College**

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

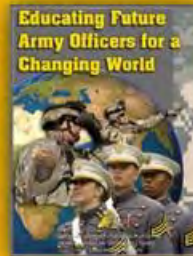
Higher Education Communities

- 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





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 are already leaning forward to include the new SOs in our AY19 assessments, in preparation for our record year (AY20)

Student Outcomes (old)

Identical to ABET a-k as described on slide 11

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

1. Apply knowledge of mathematics, science, and engineering.
2. Design and conduct experiments, as well as analyze and interpret data.
3. Design a system, component, or process to meet desired needs within economic, environmental, social, political, ethical, health and safety, manufacturing, and sustainability constraints.
4. Function on multidisciplinary teams.
5. Identify, formulate, and solve engineering problems.
6. Understand professional and ethical responsibilities.
7. Communicate effectively.
8. Understand the impact of engineering solutions in a global economic, environmental, and societal context.
9. Recognize the need and develop the skills required for life-long learning.
10. Demonstrate knowledge of contemporary issues.
11. Demonstrate an ability to use techniques, skills, and modern engineering tools necessary for engineering practice.



Student Outcomes (new)



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. to 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.

Chemical Engineering Faculty

Can we support critical courses?

	AY18	AY19	AY20	AY21	AY22	AY23
Biaglow	X	X	X	X	X	X
Lachance	a	a	?	?	?	?
Bull	X	X	X			
Kalainoff	b	b	retired			
Armstrong	X	X	X	X		
Nagelli	X	X	X	X	X	X
James	X	X	X	X	X	X
Miller, A.	X	X	X			
Pfluger		X	GENE			
Corrigan		X	X	X		
Chin				X	X	X
Yi				X	X	X
Totals	6+	8+	8+	8+	5+	3+

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

b – available to teach; currently acting department deputy

? – uncertain availability



Chemical Engineering



United States Military Academy

Example Schedule for Chemical Engineering, Classes of 2021 and Beyond



Fall Term	Course	Credit Hours	Spring Term	Course	Credit Hours
4th CLASS					
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	MA364/5	Engineering Mathematics	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 I	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

Current Curriculum

CEN1 - Class of 2021

4th Class Year Fall Term	Spring Term	3rd Class Year Fall Term	Spring Term	2nd Class Year Fall Term	Spring Term	1st Class Year Fall Term	Spring Term
<i>E</i> MA103 4.0	<i>E</i> MA104 4.5	<i>E</i> MA205 4.5	<i>R</i> CH362 3.5	<i>R</i> EE301 3.5	<i>D</i> MC300 3.0	<i>D,R</i> CH459 3.5	<i>R</i> CH402 3.0
<i>/D</i> EV203/ CH101 4.0	<i>D/R</i> CH101/ PH205 4.0	<i>R</i> PH205/ PH206 4.0	<i>R/</i> PH206/ EV203 4.0	<i>R</i> CH363 3.5	<i>R</i> CH364 3.5	<i>R</i> CH365 3.0	<i>R</i> CH400 1.5
<i>R</i> EN101 3.0	<i>R</i> EN102 3.0	<i>R</i> CH102 4	<i>R</i> MA364/5 3.0	<i>R</i> CH383 3.5	<i>R</i> MC312 3.0	<i>R</i> CH485 3.5	<i>R</i> Engr Elective 3.0
<i>E</i> IT105 3.0	<i>E</i> PL100 3.0	<i>E</i> DFL1 4.0	<i>E</i> PY201 3.0	<i>D</i> MC311 3.5	<i>D</i> CH367 3.0	<i>D</i> Engr Elective 3.0	<i>D</i> LW403 3.5
<i>R</i> HI105 3.0	<i>R</i> HI108 3.0	<i>R</i> SS201 3.5	<i>E</i> DFL2 4.0	<i>R</i> MA206 3.0	<i>R</i> SS307 3.0	<i>R</i> Engr Elective 3.0	<i>R</i> HI302 3.0
			<i>R</i> SS202 3.5	<i>R</i> PL300 3.0			<i>R</i> MX400 3.0

We began the major with 5 chemical engineering courses taught in the department.

With advisory board support, we now have **nine**.

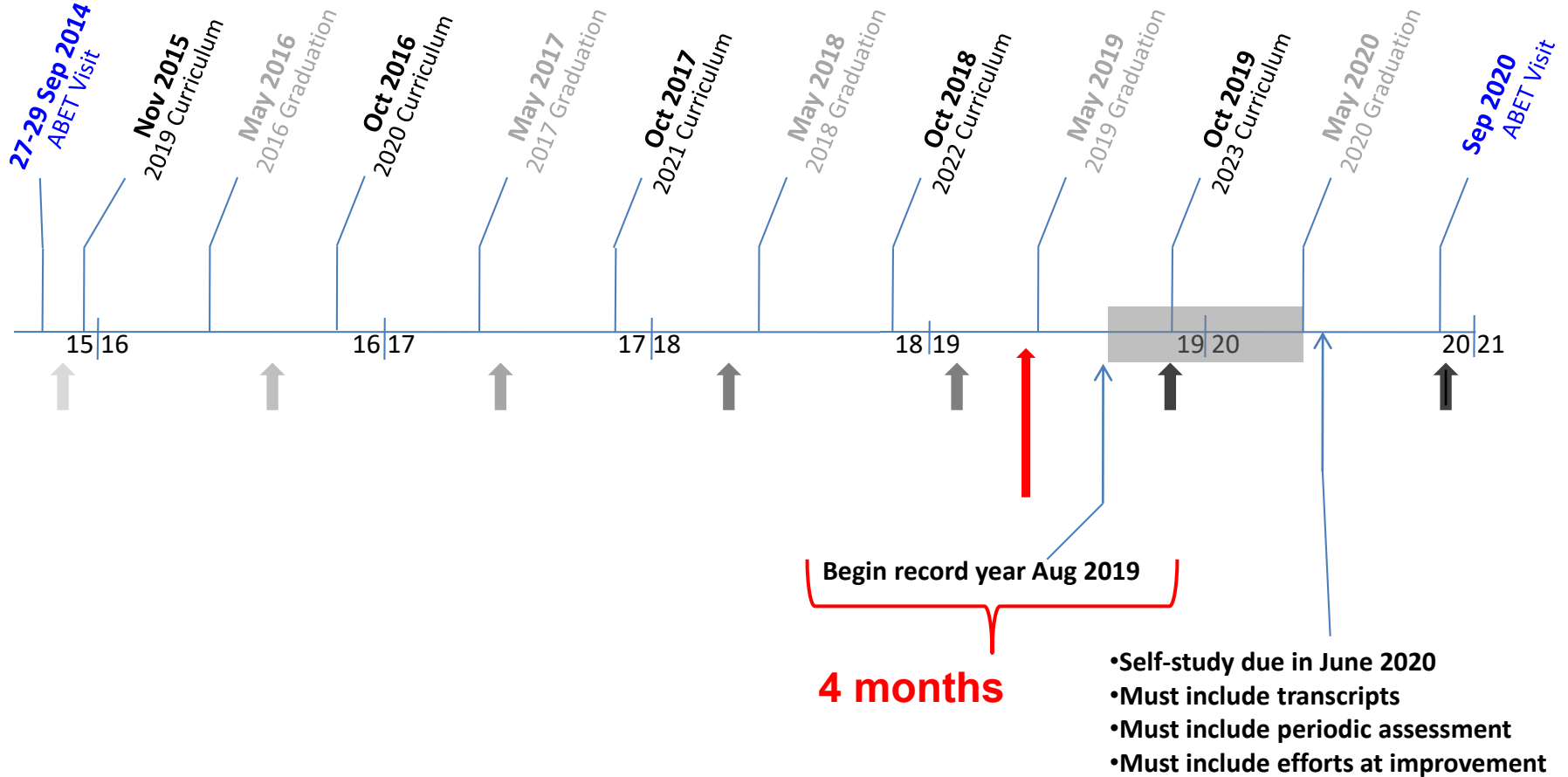
Recent Curriculum Changes and Ongoing Impact

- Plebes choose majors prior to Spring Break
 - Additional administrative requirements
 - **Trend of more changes of major (both into and out of)**
- Removal of EN302 and HI301 core courses
 - More electives required for validations
 - 'Writing Across the Curriculum'
- MA205, CH102, PH206 no longer required core courses
 - remain prerequisites for chemical engineering courses
- Introduction of CH275 – Introductory Biology
 - Acceptable alternative to CH102?
- 'Flexible' science scheduling
 - Ordering of prerequisites – program has no control

Implementing Schedule Change

- AY 19-1 the Academy's 1-day/2-day schedule will change
 - Now 40 1-days and 30 2-days
 - **Some courses must shift to a 30-lesson sequence (CH363)**
 - **CH485 shifting to 30 lesson sequence in AY20-1**
- 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

Timeline for Curricular Actions





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



Electives Proposals



- Cadets have expressed ongoing interest in more chemical engineering 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?



Proposed Bioengineering Electives



- Proposed courses as a potential Engineering Sequence
 - Meet engineering sequence requirement for life scientists
 - Electives for chemical engineers
 - Initial proposal (working DRAFTS)
 - Biomedical Engineering (Fundamentals)
 - Bioprocess Engineering (Fundamentals)
 - Biological Systems Design



Other Electives / Thoughts

- Numerical Methods for Chemical Engineering Problems
 - Enhance cadet experience with computational tools (MMA, Matlab)
 - Ready to execute
- Chemical Explosives
 - Taught before, ready to execute with instructor prep
- Thoughts on “Research” efficacy for “teaching”?



Some Administrative

- LTC Matt Armstrong and LTC Corey James taking over program leadership
- Next Advisory Board on-site
 - Late April/Early May 2020...close out Class of '19
- Travel Paperwork/Dinner settle
- Tour of Unit Operations Lab



End of Section 4



Chemical Engineering

United States Military Academy



Advisory Board Meeting

4 May 2018

Thank you!

United States Military Academy
Department of Chemistry and Life Science

Back Up Slides

Student Outcomes (old)

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Student Outcomes (old)

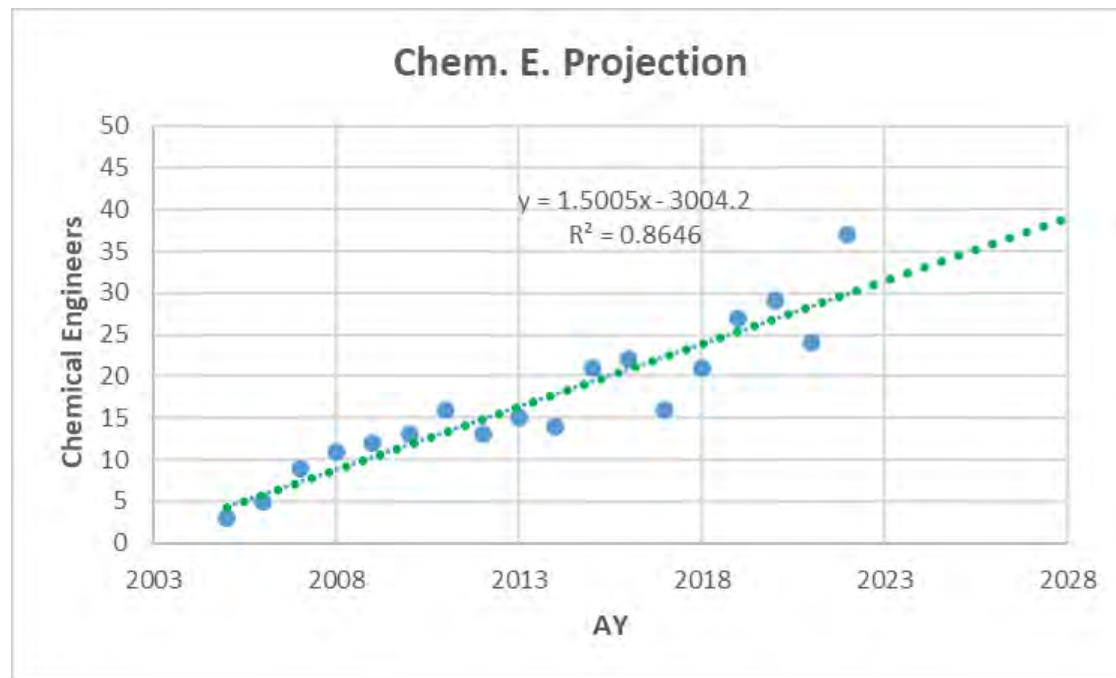
Additional outcomes articulated by the program as described on slide 11

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

- a. General, organic, and physical chemistry.
- b. Material and energy balances on chemical processes, including safety and environmental factors.
- c. Thermodynamics of physical and chemical equilibria.
- d. Heat, mass, and momentum transfer.
- e. Chemical reaction engineering.
- f. Continuous and staged separation operations.
- g. Process dynamics and control.
- h. Modern experimental and computing techniques.
- i. Process design.

Historical Data:

AY	# Chem E.
2005	3
2006	5
2007	9
2008	11
2009	12
2010	14
2011	16
2012	13
2013	15
2014	14
2015	21
2016	22
2017	16
2018	21
2019	27
2020	29
2021	24
2022	37



Future projected Chem. E.

AY	# Chem E. all yrs)
2023	31
2024	33
2025	34
2026	36
2027	37
2028	39
2029	40
2030	42
2031	43
2032	45
2034	48