Chemical Engineering

United States Military Academy

Advisory Board Meeting

4 May 2018

United States Military Academy
Department of Chemistry and Life Science

Advisory Board Meeting Agenda

4 May 2018

Time	Event	Location
0730-0745	Shuttle at 5-Star Parking Lot	5-Star
0745-0800	Arrival – Light Breakfast	CLS Conference room
0800-0830	Session 1: Introductory remarks and ABET orientation	CLS Conference room
0830-0920	Session 2: Program assessment Student Outcomes Assessment Discussion of Program Objectives	CLS Conference room
0920-0930	Board Surveys	Survey Parts 1 and 2
0930-0950	Session 3: CH367 Update	CLS Conference Room
1010-1050	Career Panel	CLS Conference Room
1100-1140	Cadet Discussions	CLS Conference Room
1200-1245	Lunch and Firstie Mock Interview Round Robin	West Point Club
1300-1330	Board backbrief on cadet interactions	West Point Club
1340-1430	Session 4: Future Challenges	CLS Conference Room
1430-1455	Admin and Unit Ops Lab tour	Bartlett Hall (Optional)
1500-1530	Wrap-up	CLS Conference Room

Lunch – West Point Club

http://www.westpointmwr.com

Lunch buffet is BBQ Salmon, honey roast corned beef, and a potato

Chemical Engineering

United States Military Academy

Advisory Board Meeting

4 May 2018

1. Introductory Remarks

United States Military Academy

Department of Chemistry and Life Science

Thank You! Advisory Board 2017-2018

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	**COL (Ret) Paul Dietrich** ✓ 3855 Victory Blvd Staten Island, NY 10314-6716 718-698-8526 paul@the-dietrichs.com
LTC Andrew Pfluger✓ US Army Student Detachment Colorado School of Mines 845-545-2235 andrew.r.pfluger.mil@mail.mil	**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	**Anthony Hatfield**✓ Eli Lilly and Company Consultant Engineer Indianapolis Parenteral Manufacturing Cartridge Facility 317-655-0429 hatfieldan@lilly.com
Donald C. Glaser✓ President, Simulation Solutions, Inc. 179 Avenue at the Common Shrewsbury, NJ 07702 732-389-5400 dglaser@simulation-solutions.com	**Matt Garvey**✓ Simulation Solutions, Inc. Shrewsbury, NJ mgarvey@simulation-solutions.com	
COL (Ret) Vance P. (Phil) Visser 2925 Thomas Smith Lane, Williamsburg, VA 23185 philvisser@yahoo.com 757-254-3017	**COL (Ret) Dwight Springer** Former Deputy Head Chemistry and Life Science US Military Academy 817-431-5331 dss5456@verizon.net	**Anthony Pavone** Process Economics Program HIS Chemicals (650) 384-4311 tonypavone@ihs.com

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

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.

"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.

ABET | 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.

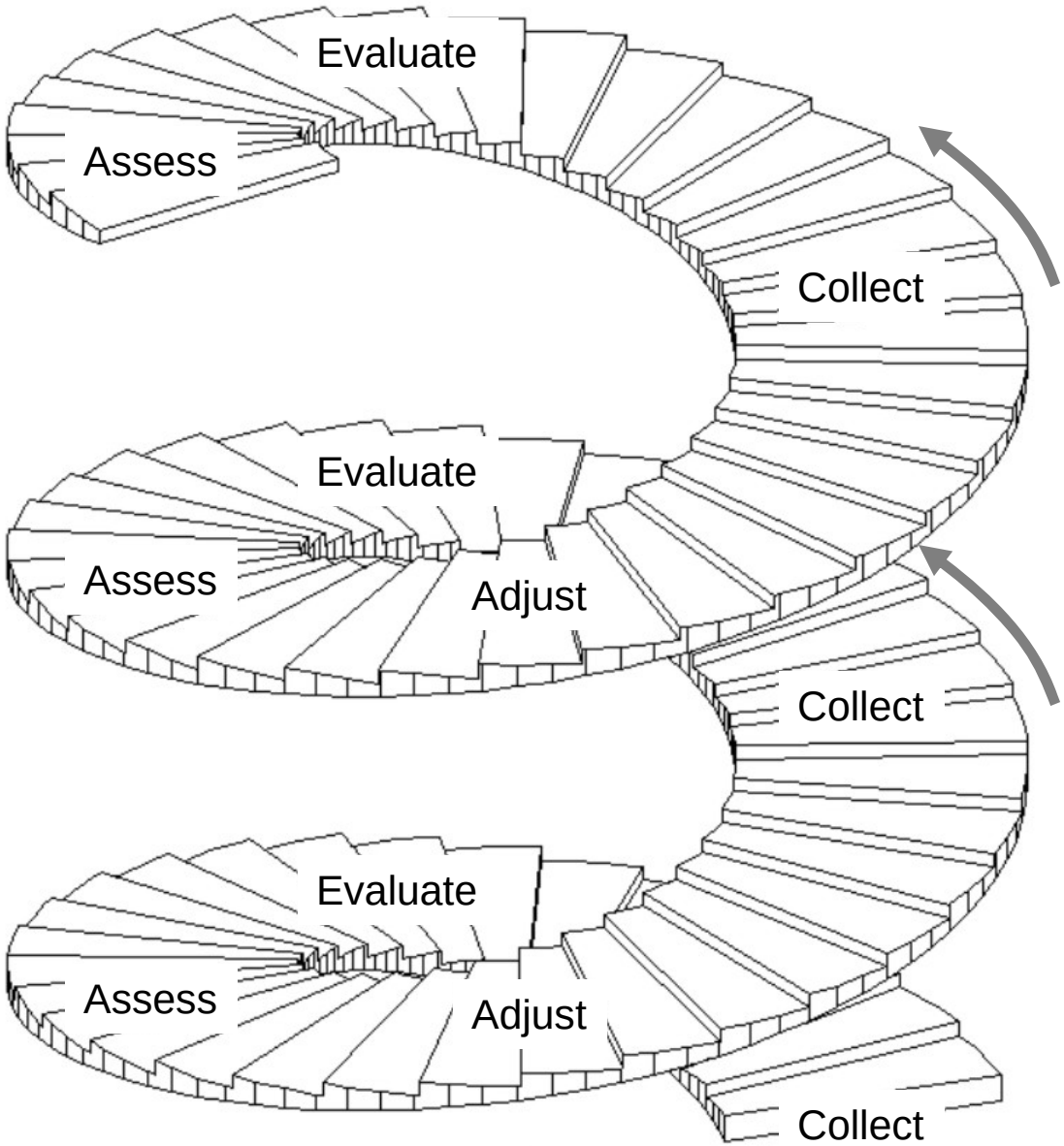
Thoughts to Consider

- 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

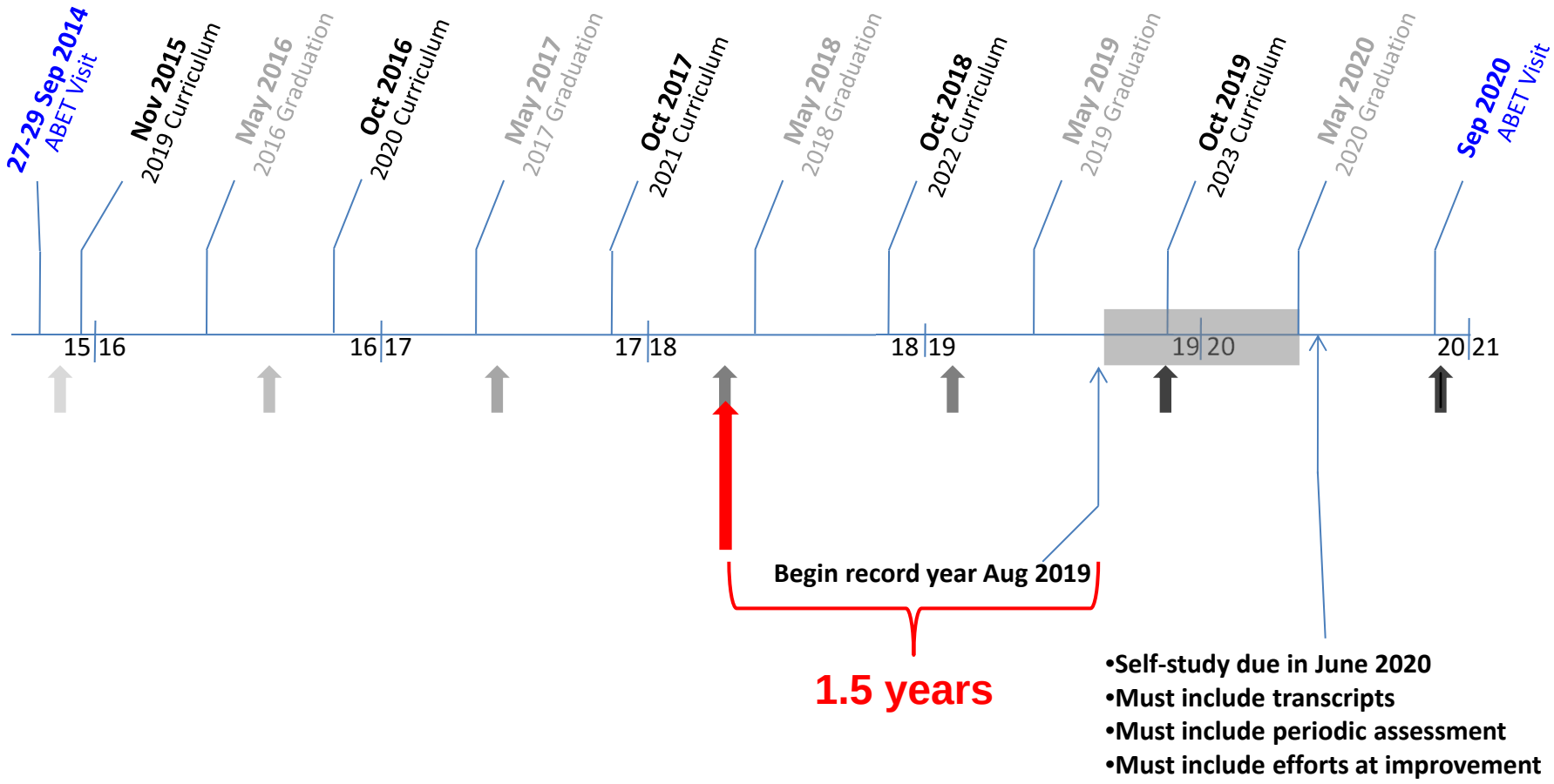
Terms You Should Know

- **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 14 April 2017

- The USMA program satisfies ABET requirements while meeting the mission and vision of both the Army and the Academy.

- ChE courses required at USMA cover the spectrum of topics relevant to ChE practice, both within the Army and in the private sector.

- The inclusion of more time with cadets via the resume/interview session was unanimously viewed as positive.

- The initial direction for the new CH367 appears appropriate. Suggestions were provided for potential topics to be included.

- Cadets continue to express widespread dissatisfaction with the MC300 course, finding it not useful

- Cadets were pretty universally supportive of the addition of CH367 in lieu of XE472

Advisory Board Opportunities for Improvements

Excerpts from Minutes of 14 April 2017

- Cadet feedback indicated continued support for elective courses within the chemical engineering program and the chemistry department more generally.
    - Discussions for curriculum change for inclusion of electives or other course replacements (e.g., MC300) are ongoing but are currently limited by faculty resources

- More effective technical communication training should be provided. Consideration of a technical writing course (CH300) would improve the program, and should also cover the effective visual display of technical information (Edward Tufte program).

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

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

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.

Required Courses * (for classes 2017, 2018, 2019)	
MA366	Engineering Mathematics with Applications
CH362	Mass & Energy Balances
CH363	Separation Processes
CH364	Chemical Reaction Engineering
XE472	Dynamic Modeling & Control
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**

Required Courses * (for classes 2020+)	
MA366/MA365	Engineering Mathematics with Applications
CH362	Mass & Energy Balances
CH363	Separation Processes
CH364	Chemical Reaction Engineering
~~XE472~~	~~Dynamic Modeling & Control~~ **CH367 Introduction to Automatic Process Control**
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

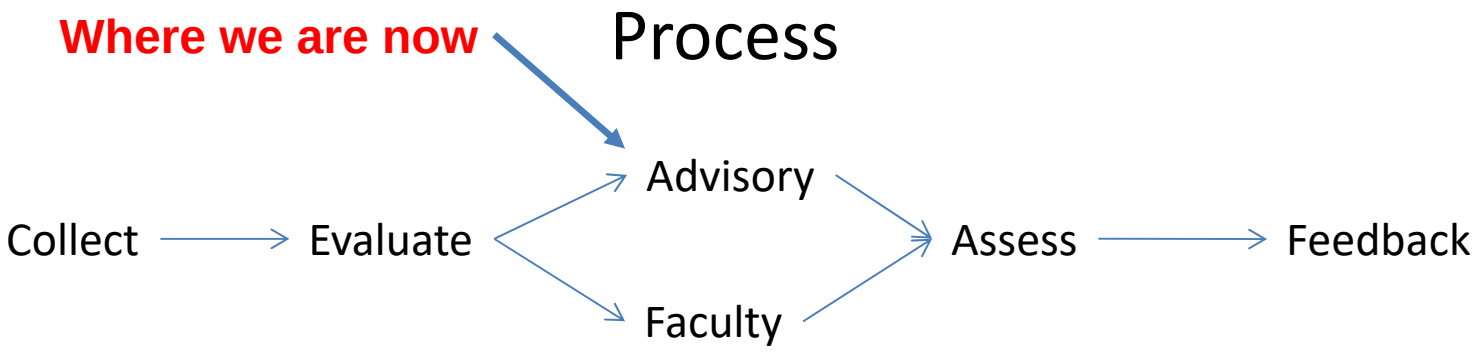
Fundamentals of Engineering Exam Topics

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 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**

Current Curriculum

CEN1 - Class of 2021

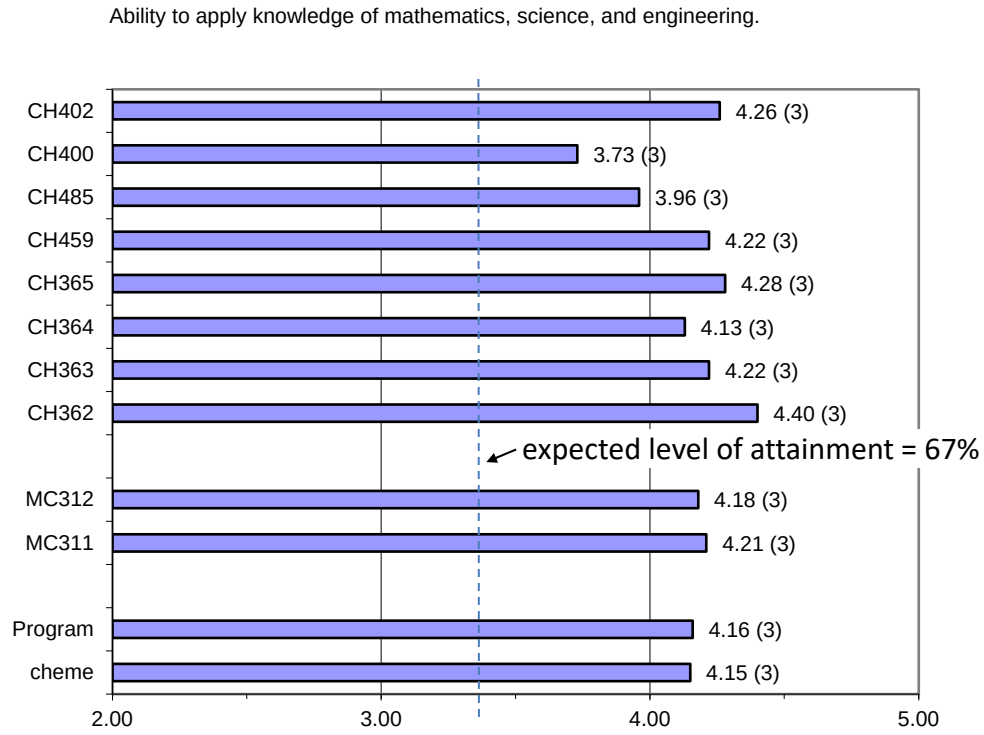
4th Class Year Fall Term	Spring Term	3rd Class Year Fall Term	Spring Term	2nd Class Year Fall Term	Spring Term	1st Class Year Fall Term	Spring Term
E **MA103** 4.0	*E* **MA104** 4.5	*E* **MA205** 4.5	*R* **CH362** 3.5	*R* **EE301** 3.5	*D* **MC300** 3.0	*D,R* **CH459** 3.5	**CH402** 3.0
/D **EV203/ CH101**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

Student Outcome 1

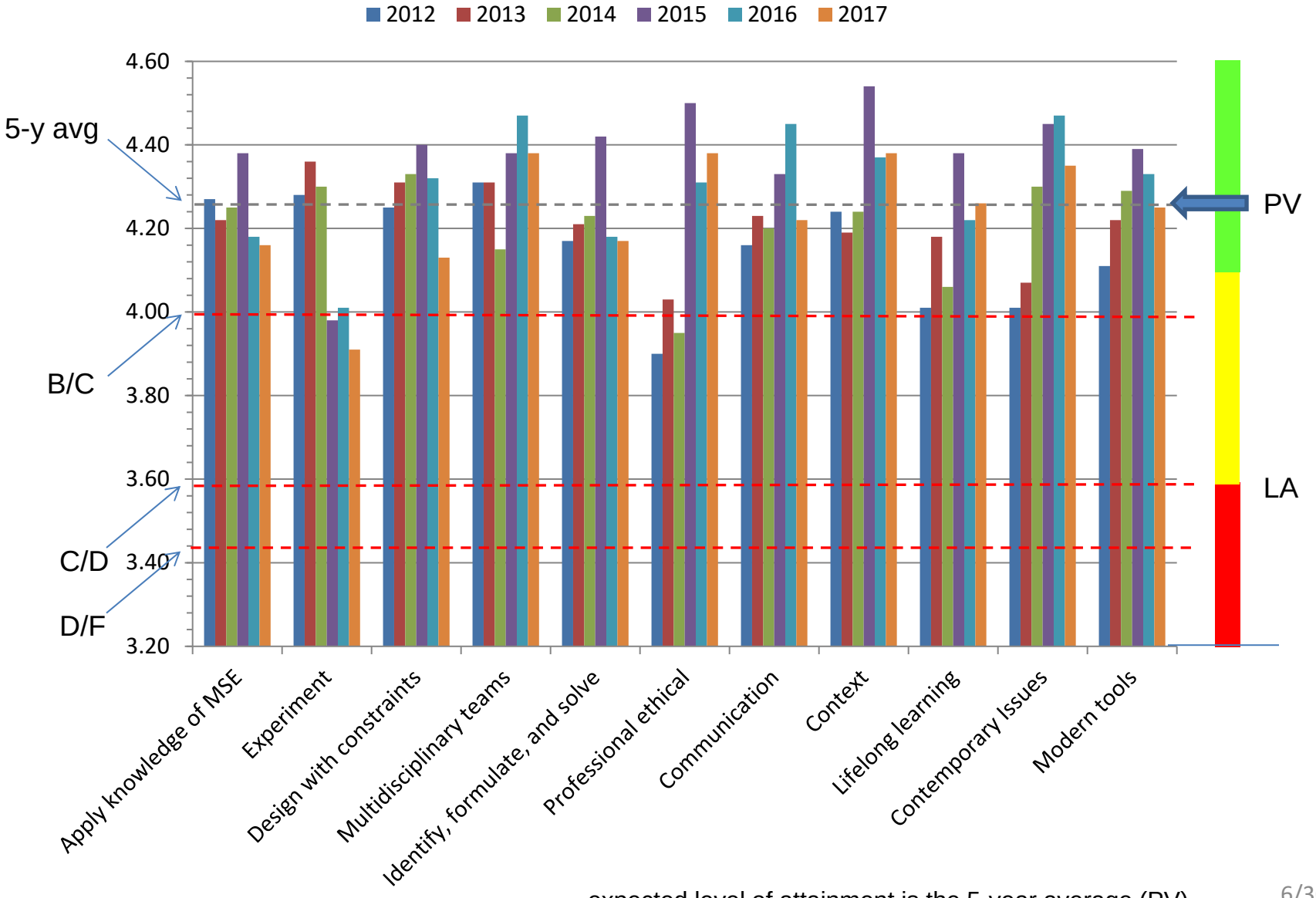


Values in parentheses are coverage ratings from Table 5-3 in the Self Study, page 5-9

Data shown here is for Class of 2017
Similar data is collected for all 11 ABET outcomes
Summary of all data is shown on next slide
(AY17 is assessed using old outcomes)

Performance on Embedded Indicators

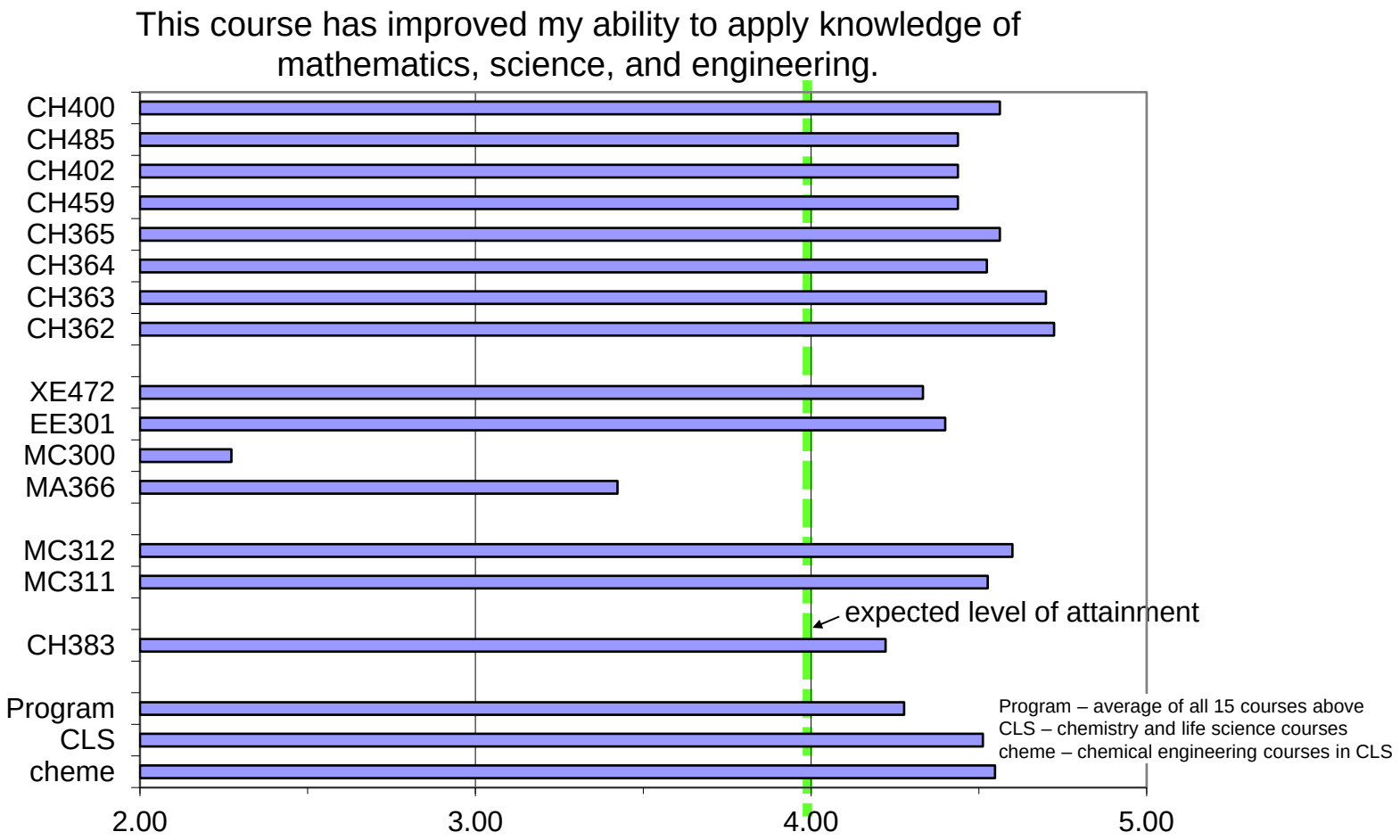
Program Averages AY2012 to AY2017



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

Example Data: End-of-Semester Surveys

Student Outcome 1



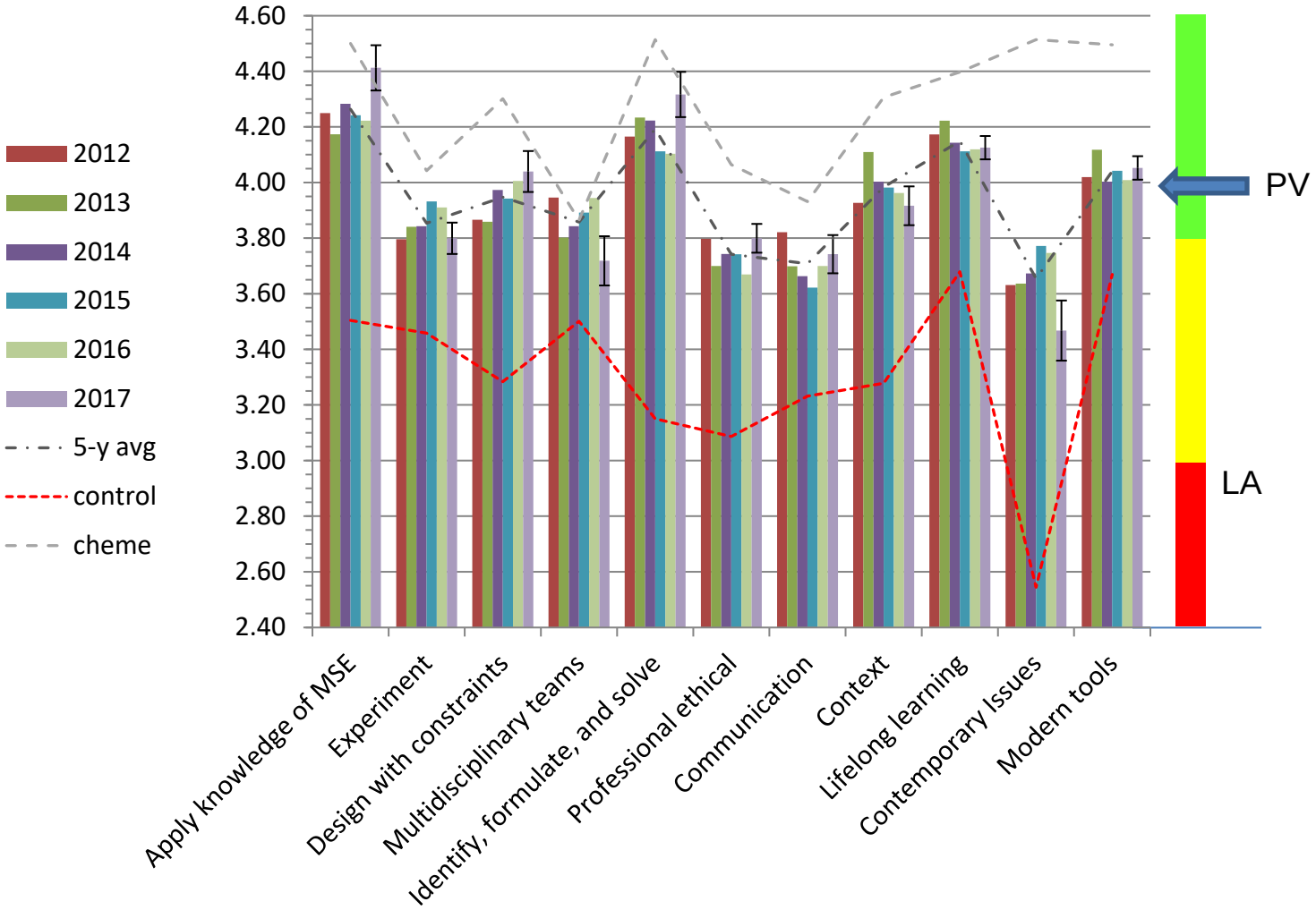
Data shown here is for Class of 2017

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 AY12-17

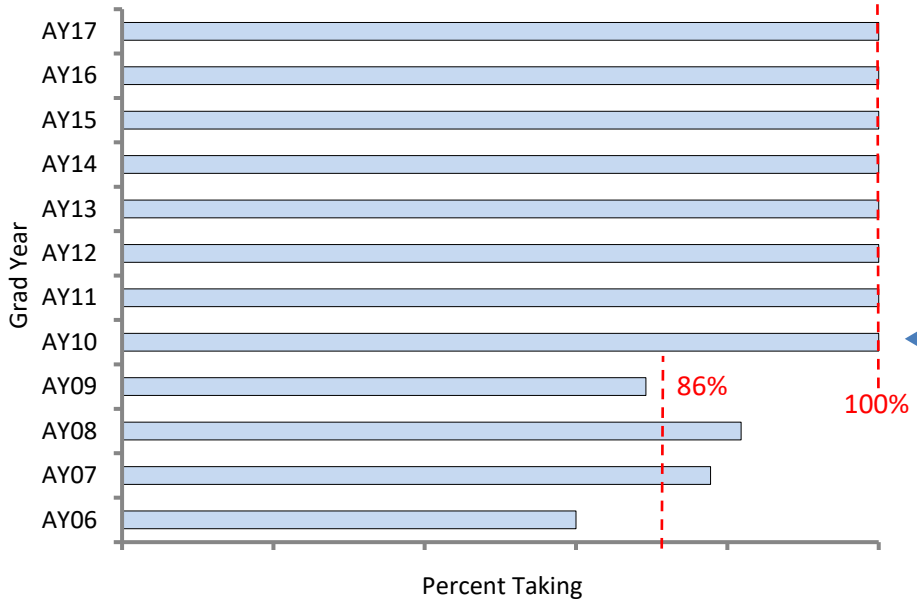


expected level of attainment is the 5-year average (PV)

Fundamentals of Engineering Exam

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

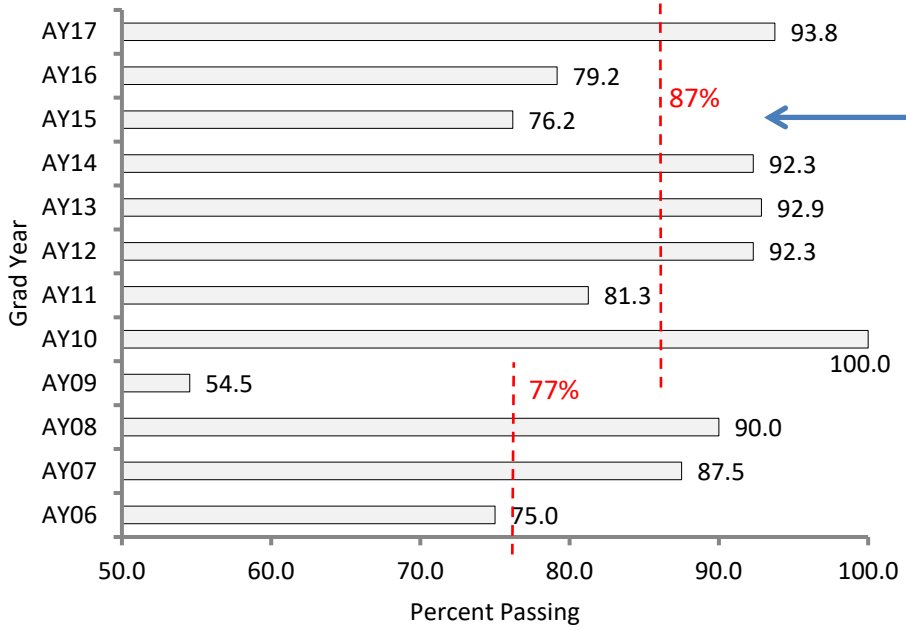
Percent taking



Percent passing

National, (+/- ~1%):

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%



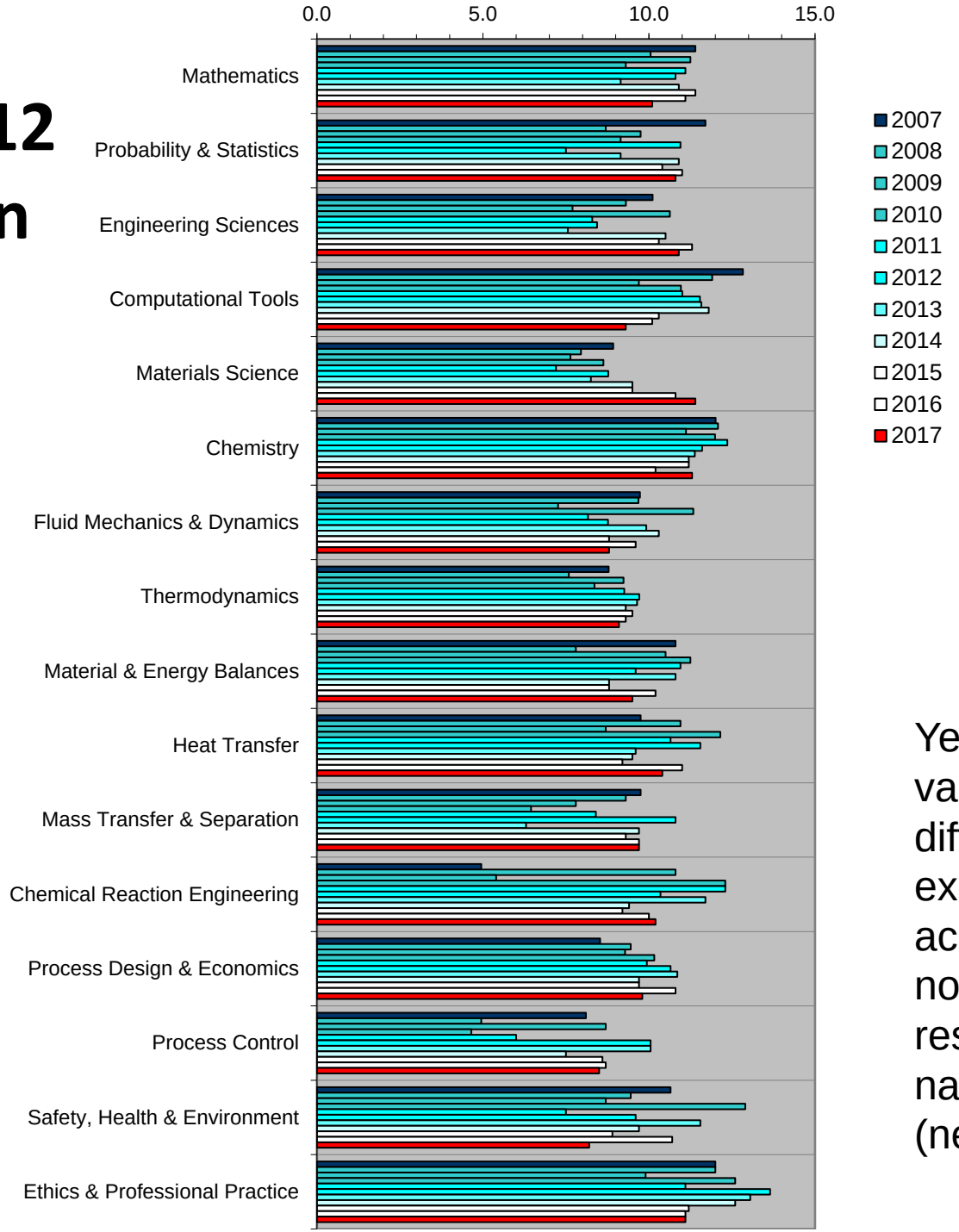
CH400 Initiated

Electronic Testing

Outcome 12 Evaluation

FEE Results

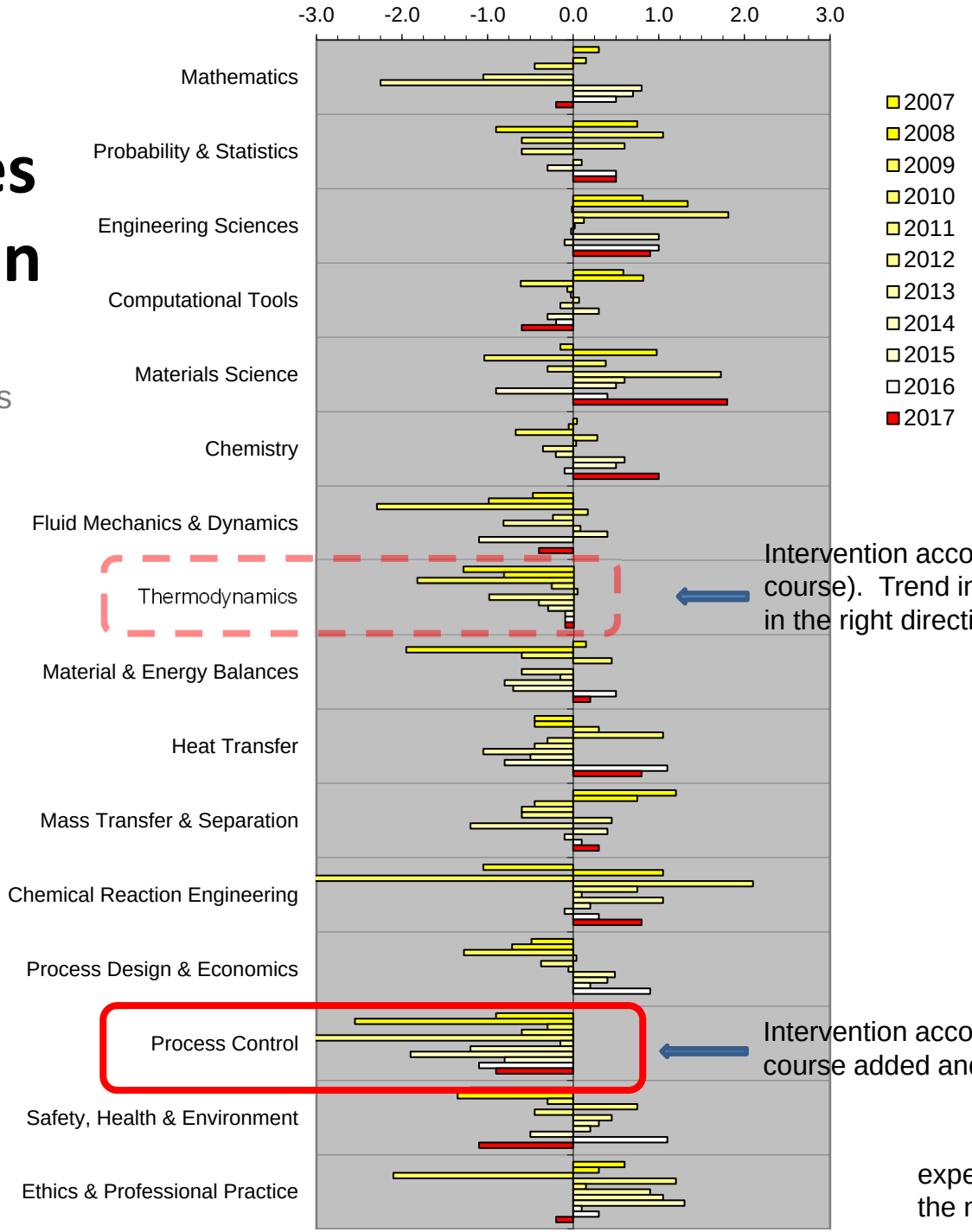
Performance Indicators AY07 to AY17



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

Topical Outcomes Evaluation

Deviations from National Averages AY07 to AY17



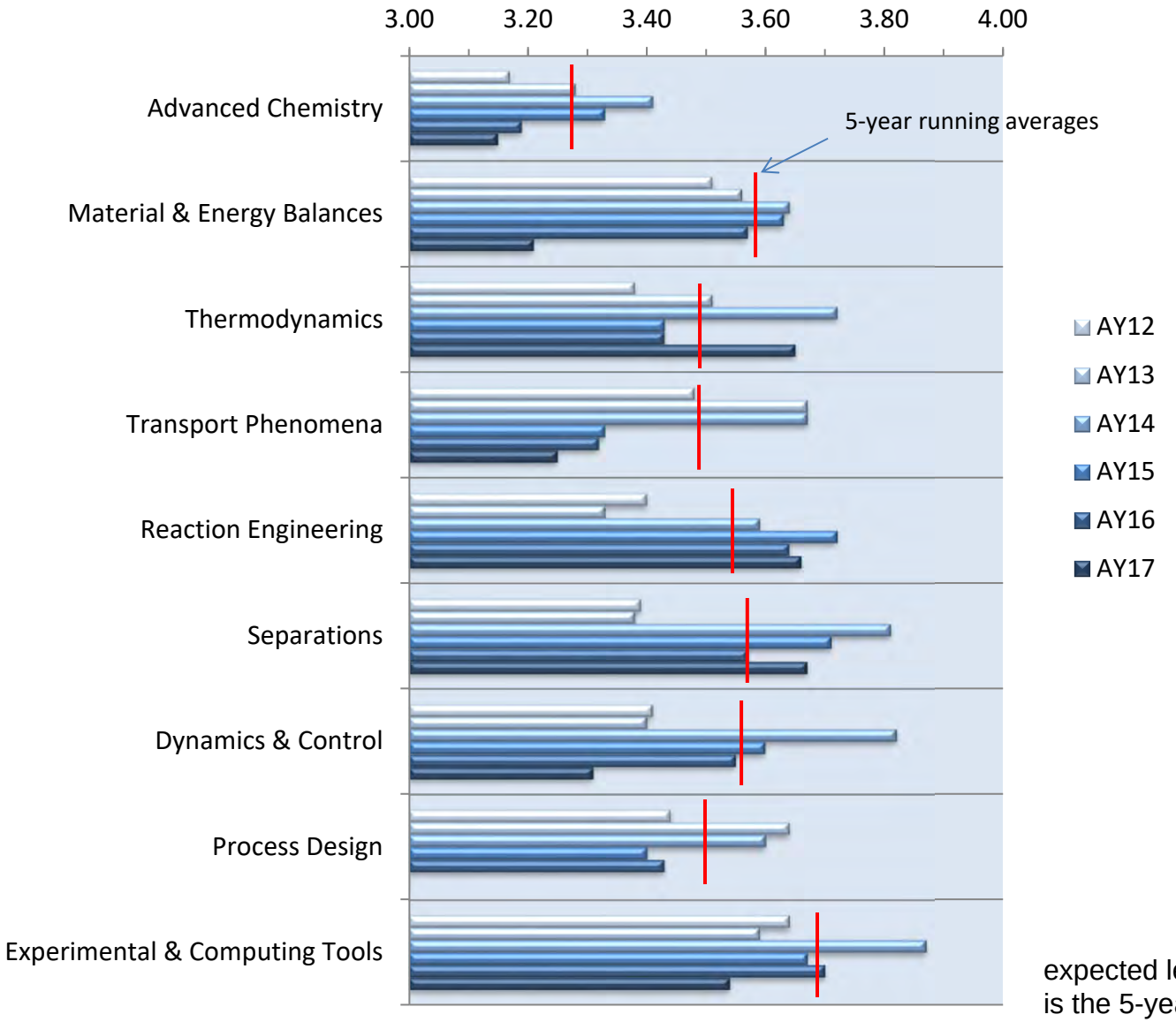
Intervention accomplished in AY13 (new course). Trend in performance continues in the right direction.

Intervention accomplished in AY16 (new course added and implemented 19-2

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

Topical Outcomes Evaluation

Average Course GPA from Transcripts, AY2012 to AY2017

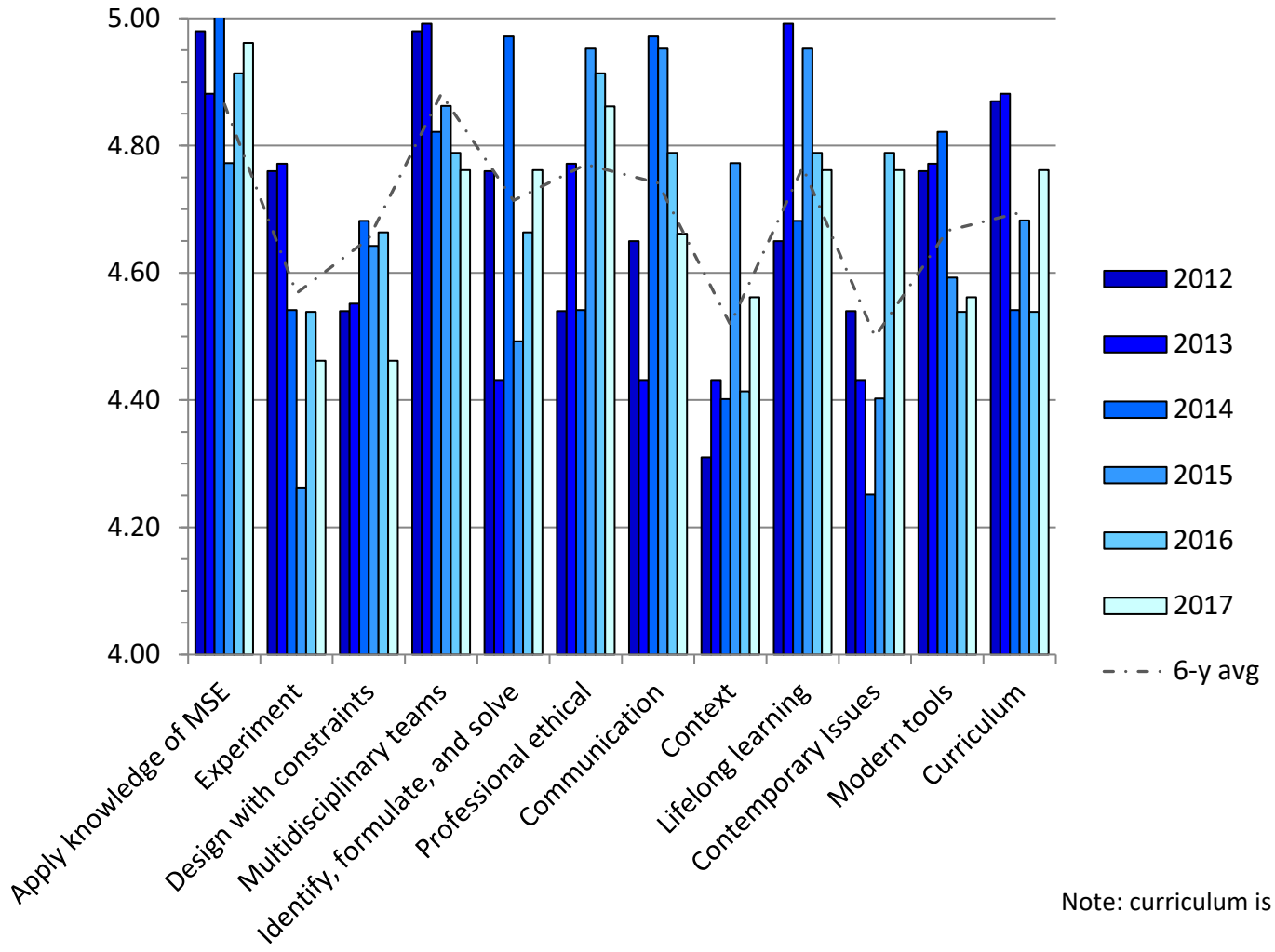


expected level of attainment is the 5-year average

Advisory Board Student Outcomes Surveys

Normalized Program Averages from AY12-17

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

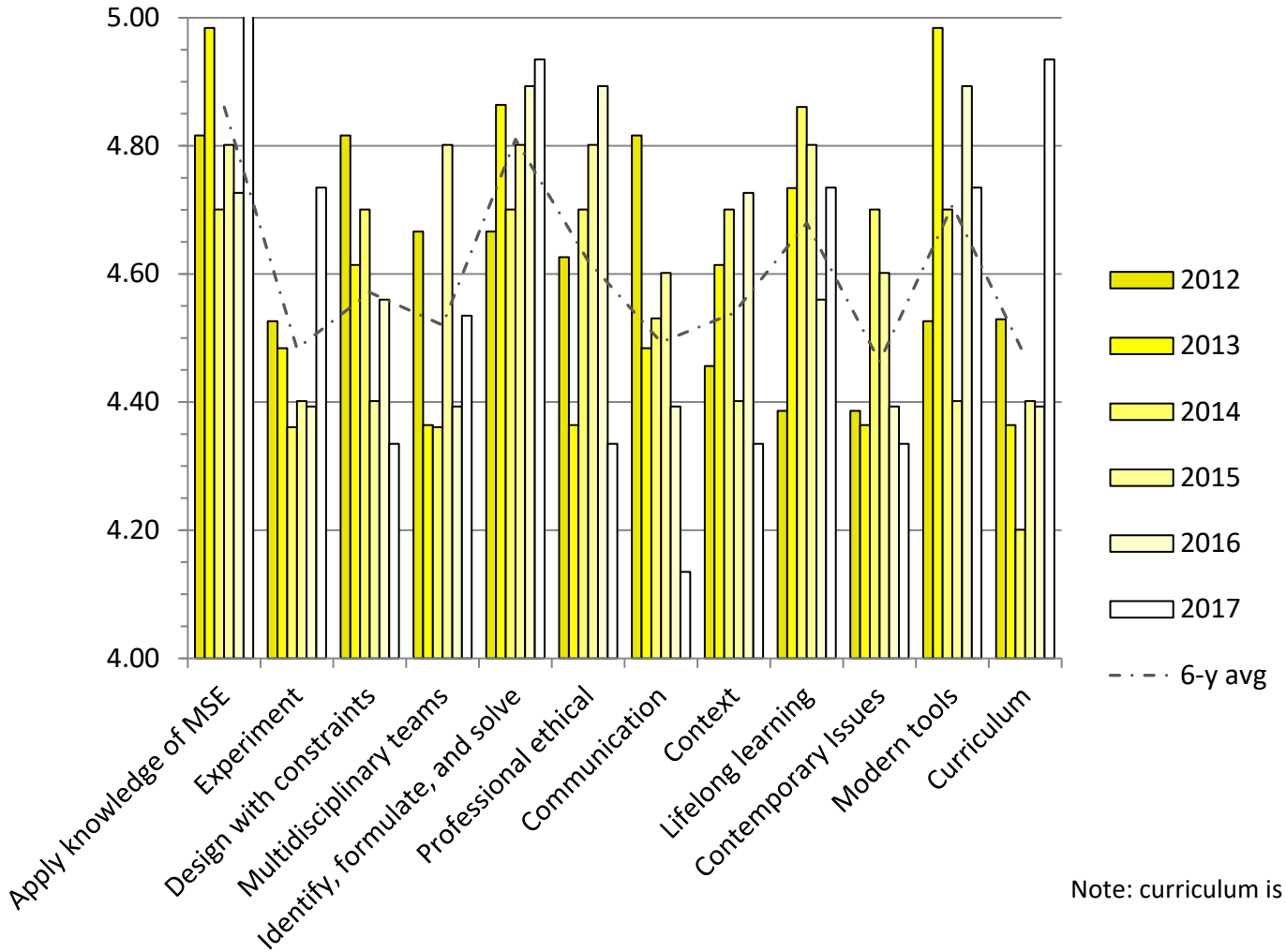


Note: curriculum is outcome 12

Faculty Student Outcomes Surveys

Normalized Program Averages from AY12-17

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



Note: curriculum is outcome 12

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

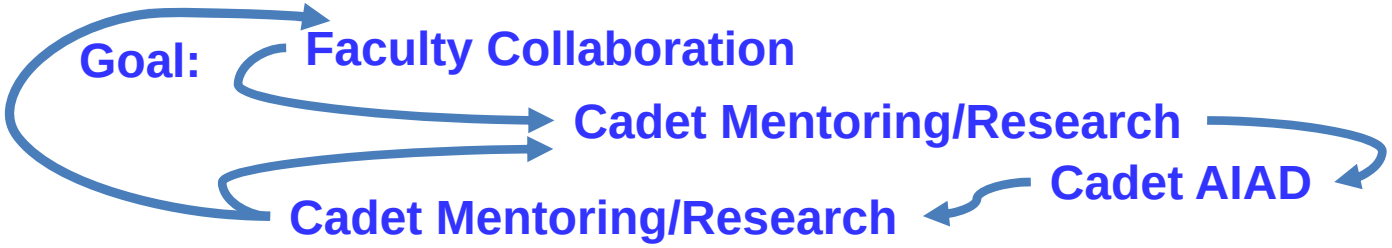
Program Advisory Board Surveys
Program Faculty Surveys
Program Cadet Surveys

Strategy going forward:

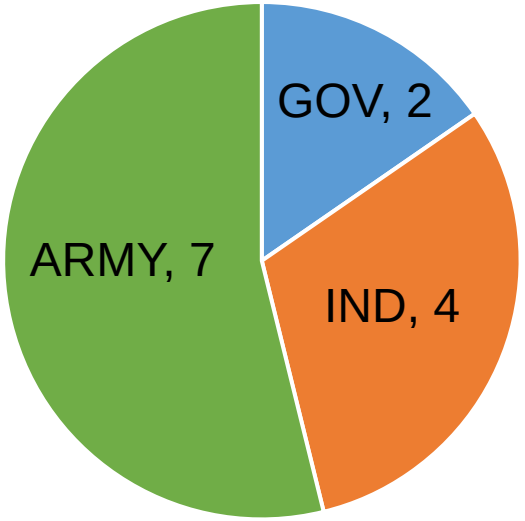
Assess consistency with the mission of the institution and the needs of the constituencies improve objectives.

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

Advisory Board Meeting

4 May 2018

3. Introduction to 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

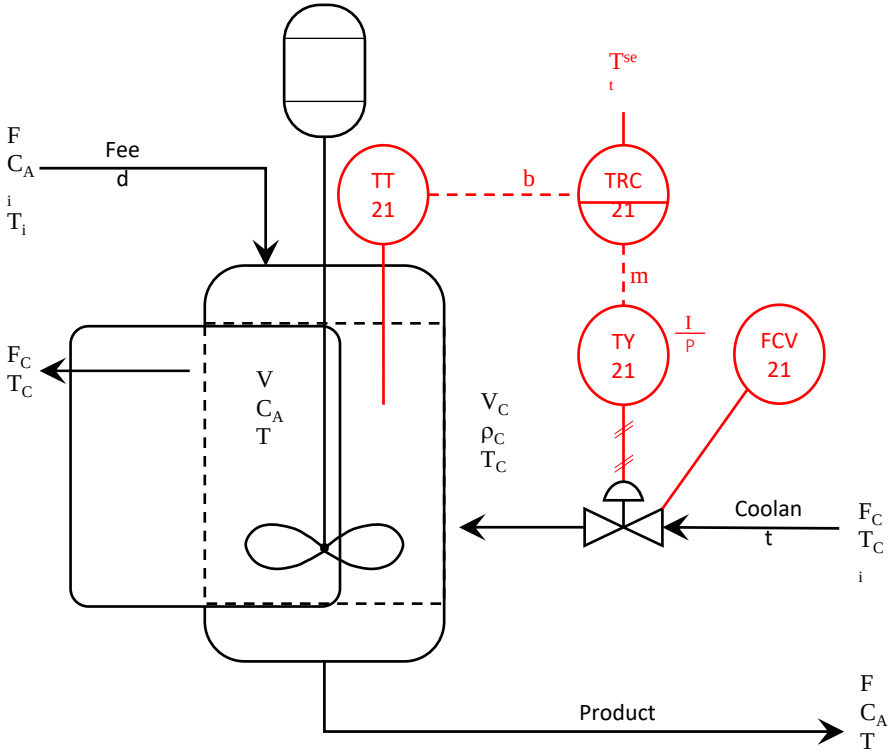
This course covers the principles necessary to understand the automatic control of chemical processes. Students learn the current mathematical models and mechanical details of various control elements, including sensors, transmitters, actuators, and controllers. Application of mathematical models will 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

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

CH367 Capstone



Objectives

1. Write a descriptive interpretation of each element in a control loop.
2. Draw a complete Laplace block diagram for an actual control loop.
3. Design and implement a PI controller for a chemical reactor, and implement a numerical solution to the equations that describe the process dynamics.
4. Tune a controller.

CH367: Block Organization

Block of Instruction	Topics
Block I Introduction and Mathematics of Process Controls	includes: Linearization, Laplace and Inverse Laplace transforms, Laplace space/domain, Euler's Method
Block II First and Higher Order Dynamic Systems	
Block III Basic Components and Control Elements of Control Systems	includes: Proportional control, Integral control, Derivative control, PID control, Sensors/digital/mechanical switch
Block IV The Transfer Function	
Block V Feedforward, Multivariable Process Control	
Block VI Putting it all Together: Capstone Project	

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?

~ 1045-1140 Cadets ask questions of board

Lunch – West Point Club

WPC
WEST POINT CLUB
An American Tradition

http://www.westpointmwr.com/club/index.html

Chemical Engineering

United States Military Academy

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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

Strategic Influence

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

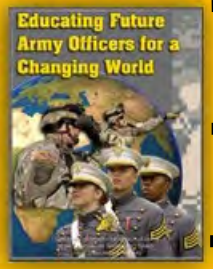
Department of the Army
- Army Goals and Priorities
- Army Regulations
- Army Doctrine

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 AY18 and AY19 assessments, in preparation for our record year (AY20)

Student Outcomes

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

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.

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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	?	?	?	
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	X	X		
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 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**

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
E **MA103** 4.0	*E* **MA104** 4.5	*E* **MA205** 4.5	*R* **CH362** 3.5	*R* **EE301** 3.5	*D* **MC300** 3.0	*D,R* **CH459** 3.5	**CH402** 3.0
/D **EV203/ CH101** 4.0	*D/R* **CH101/ PH205** 4.0	*R* **PH205/ PH206** 4.0	*R/* **PH206/ EV203** 4.0	*R* **CH363** 3.5	*R* **CH364** 3.5	**CH365** 3.0	**CH400** 1.5
EN101 3.0	**EN102** 3.0	*R* **CH102** 4	**MA364/5** 3.0	*R* **CH383** 3.5	**MC312** 3.0	*R* **CH485** 3.5	**Engr Elective** 3.0
IT105 3.0	**PL100** 3.0	*E* **DFL1** 4.0	**PY201** 3.0	*D* **MC311** 3.5	**CH367** 3.0	**Engr Elective** 3.0	*D* **LW403** 3.5
HI105 3.0	**HI108** 3.0	*R* **SS201** 3.5	*E* **DFL2** 4.0	**MA206** 3.0	**SS307** 3.0	**Engr Elective** 3.0	*R* **HI302** 3.0
			R **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**.

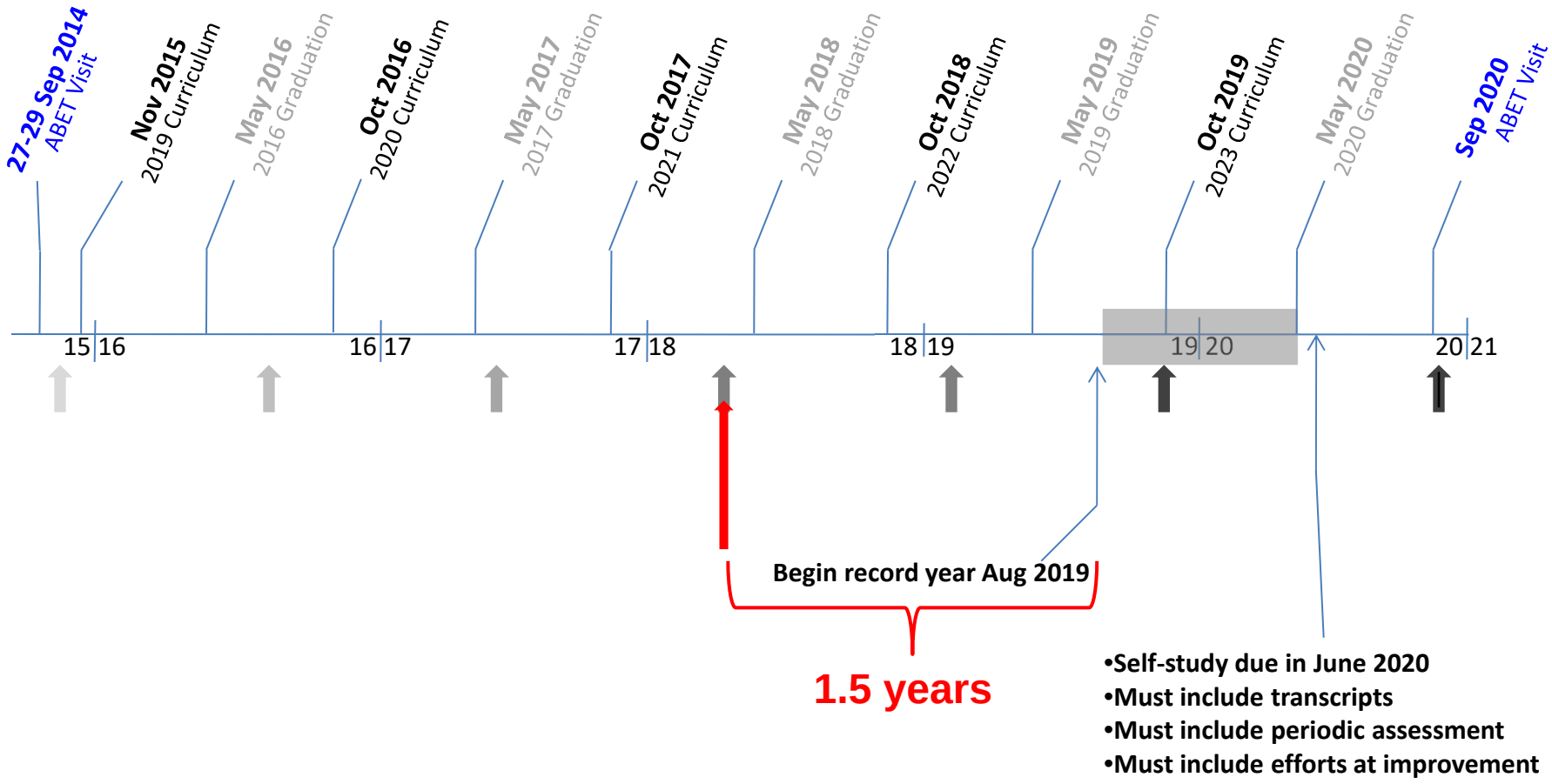
Recent Curriculum Changes and Ongoing Impact

- 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)**
- 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”?

Proposed Curriculum Change 1

CH300 Technical Writing

- Response to curriculum changes.
- Perceived shortcoming in cadet writing ability across the Corps
- Dean is currently requiring us to sacrifice technical content from one of our courses to address perceived shortcoming.
- Opportunity for us to engage in engineering-specific communication skills
  - USMA objective
  - ABET Criterion
  - PROGRAM Objective (advisory board)

Apparently unconnected with program assessment. Anecdotal evidence driving the assessment at USMA level. This approach has some risks associated with ABET. However, our choices are limited and we would like to make the best of it.

Proposed Curriculum Change 2

Addition of CH401 Chemical Engineering Design Principles

Assign 3.0 credit hours in AY20??

Reason - bolster the USMA chemical engineering performance on design principles in embedded indicators

Precedent - Parity with other USMA programs

1. EE400 – EE Professional Considerations
2. CS400 – Computer Science Seminar
3. MX400 – Officership

Proposed Curriculum Change 3

CH359 Engineering Measurements

- Response to observations in CH459.
- Improvements needed in cadet understanding of basic measurements and measuring devices.
- Improvement needed in cadet understanding of measurement error.
- Opportunity for us to enhance the controls thread.
- Opportunity to fill hole left by removal of CH371 Analytical Chemistry (2010).

Proposal

- Proposal:
  - Increase the pool of advisory board members
  - Rotate on-site visiting members on bi-annual basis (i.e., visit ~every other year)
- Rationale:
  - Ease traveling for board members
  - New/broader/different experiences for interface with cadets
  - Some cost efficiencies (couldn't support larger pool every year)

Some Administrative

- LTC Matt Armstrong and LTC Corey James taking over program leadership
- Next Advisory Board on-site
  - Late April/Early May 2019
  - Coincide with USMA Projects Day – invite 1-2 board members to come a day early and participate as a judge.
- 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