
***PROCESS ECONOMICS PROGRAM***

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20 April 2016

## MINUTES OF USMA CHE ADIVISORY BOARD MEETING

The chemical engineering advisory board met on 8 April 2016, to assess the ChE academic program for USMA undergraduates, and to provide guidance to the ongoing efforts for improving the program. The composition of the advisory board is listed in appendix 1. The agenda for the day is listed below.

| Time | Event | Location |
|---|---|---|
| 0730-0745 | Shuttle at Buffalo Soldiers Field | BSF |
| 0800-0815 | Arrival | PRC Conference room |
| 0815-0845 | Session 1: Introductory remarks and ABET orientation | PRC Conference room |
| 0845-1000<br>0830-0905<br>0915-1000 | Program assessment<br>Session 2: Student Outcomes Assessment<br>Session 3: Discussion of Program Objectives | PRC Conference room<br>Survey Part 1<br>Survey Part 2 |
| 1010-1100 | Career Panel | PRC Conference Room |
| 1110-1155 | Cadet Discussions | PRC Conference Room |
| 1200-1330 | Lunch and Backbriefs | West Point Club |
| 1340-1430 | Session 4: Future Challenges<br>New Curriculum; Proposed courses: in major, bioengineering sequence | PRC Conference Room |
| 1430-1455 | Admin; Facilities and construction tour | Bartlett Hall (Optional) |
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## USMA ChE PROGRAM RECEIVES ABET ACCREDITATION

After many years of diligent effort, the chemical engineering program at USMA-West Point became ABET accredited in September, 2015, retroactive to 1 October, 2012.

## ADVISORY BOARD BACKGROUND INFORMATION

The advisory board reviewed the USMA mission and vision, and the ChE program vision and mission, in order to consider modifications. One suggestion was to incorporate into the program mission an enhanced ability of officer graduates to rapidly evaluate situations in a dynamic environment. Wording addressing this will be developed by faculty for future consideration.

## ADVISORY BOARD EVALUATION CRITERIA

The advisory board reviews the results of numeric metrics utilized to determine whether the ChE program satisfies both ABET and USMA criteria for compliance with mission and vision. The evaluation procedure closely follows the ISO9000 continuous improvement methodology of setting objectives, establishing measurement metrics, quantifying results, analyzing the data, and modifying the program to improve results (collect, evaluate, assess, adjust). USMA ChE graduates are expected to possess the following capabilities, as a result of the academic program training they receive at the Academy.

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.

The ChE course curriculum at USMA is focused on the following specific areas of math and science. Appendix 2 lists required ChE courses.

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.

Current ChE engineering concentrations include materials engineering, nuclear engineering, decision analysis, advanced control systems, energy conversion systems, power systems, alternative energy engineering, and industrial engineering. Proposed for the future is a concentration in bioengineering.

## ADVISORY BOARD EVALUATION METRICS

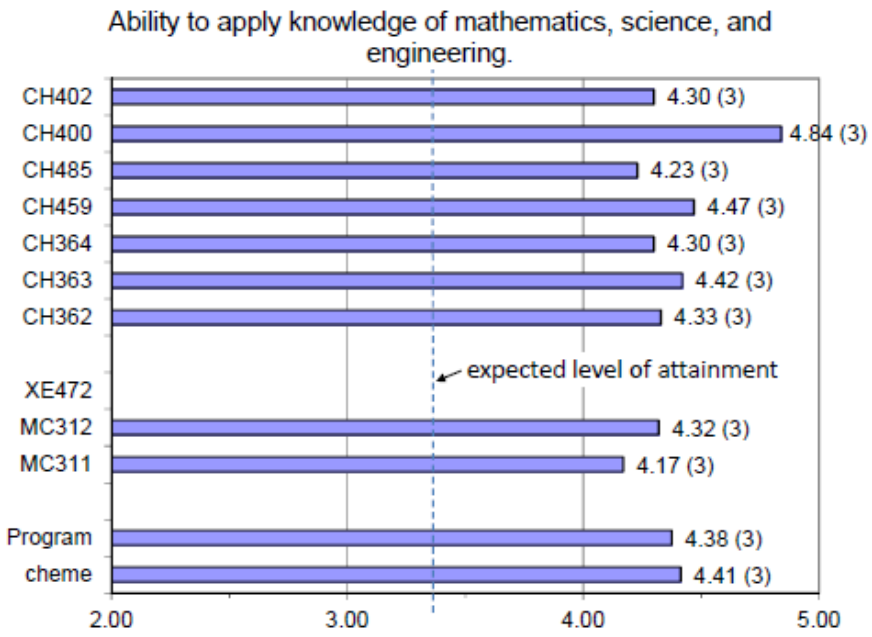
5 principal sources of data are used by the advisory board to evaluate the extent to which the ChE program satisfies mission and vision.

- Cadet course grade performance in ChE classes at the Academy
- Cadet semester end-of-course evaluations
- Cadet assessment of ABET outcomes
- Cadet performance on the 'Fundamental of Engineering (FE)' exam
- Numerical evaluations supplied by the Advisory Board to the program

Other data sources that influence the evaluation of the program include periodic survey results by graduates that are mandated by the Army at the 3 and 5 year points post-graduation, as well as the cadet program exit survey at graduation. Beside the survey results of the advisory board, surveys are also conducted of the program faculty, cadets while in school, and cadets upon and then after graduation.

## ChE COURSE GRADE PERFORMANCE

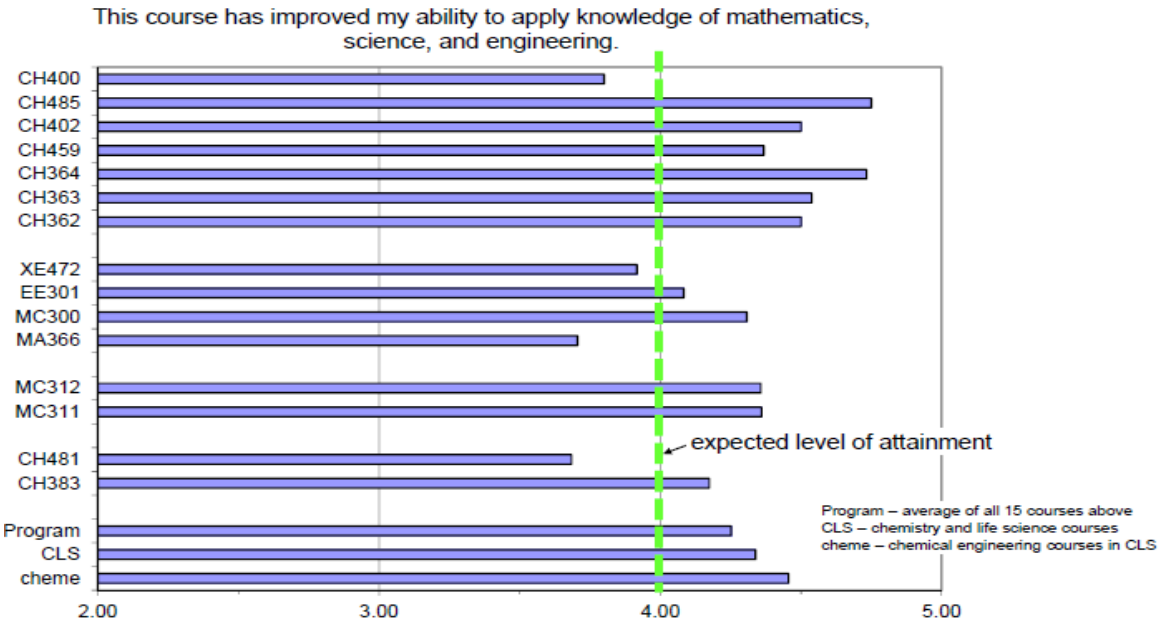
Below are the aggregate course grades achieved by cadets in the ChE program for the Class of 2015. Each of the courses resulted in aggregate grades above the expected level of attainment (3.25). The courses with the highest grades were: Professional Practice (CH400), ChE Lab (CH459), and Separation Processes (CH 363). The lowest grades were: Thermal-Fluid Systems 1 (MC311), Heat & Mass Transfer (CH485), and Chemical Reaction Engineering (CH364).



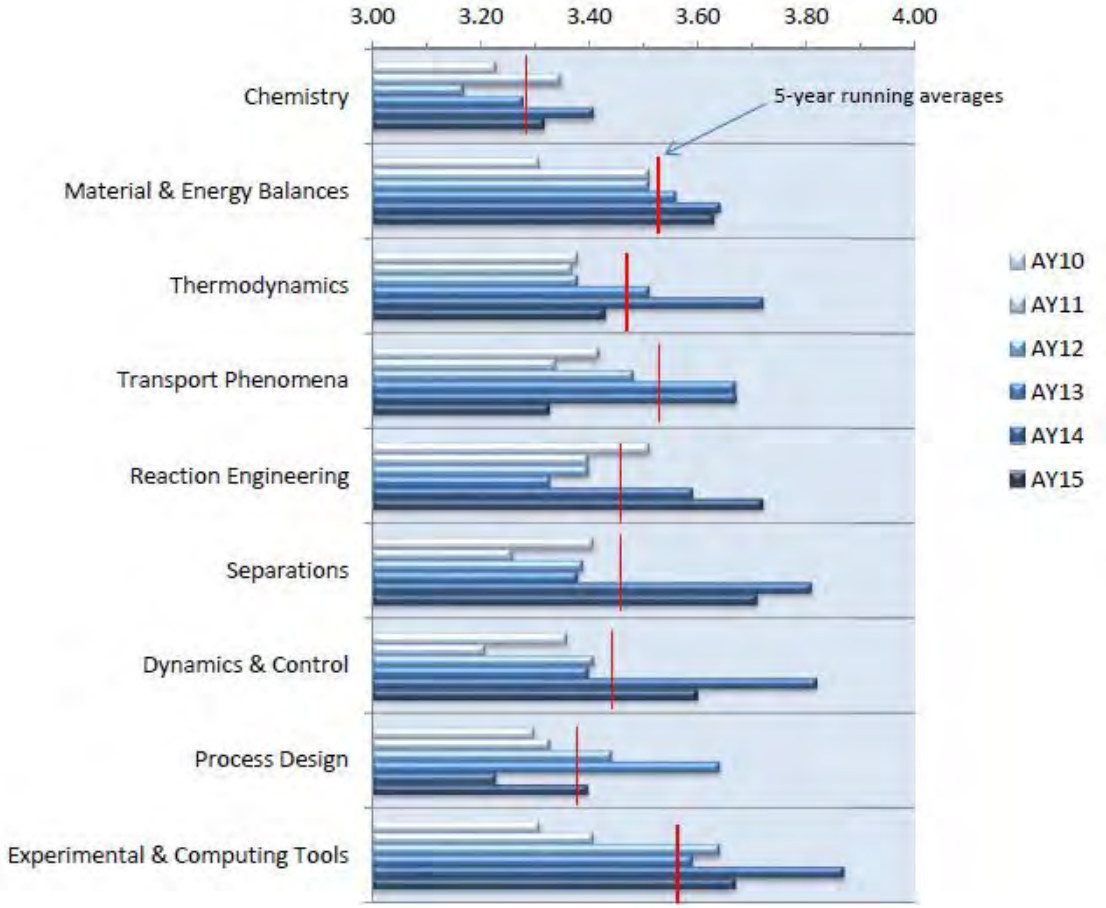

Values in parentheses are coverage ratings from Table 5-3 in the Self Study, page 5-9

## ChE END OF COURSE STUDENT ASSESSMENTS

The end of course survey of cadets provided information on how well the cadets felt that each course achieved its objectives. The survey results are plotted in the graph below. The highest ranked courses were Heat & Mass Transfer (CH485), Chemical Reaction Engineering (CH364), and Separation Processes (CH363). The lowest ranked scores, which did not meet the expected levels of attainment, were Physical Chemistry 1 (CH481), Engineering Mathematics (MA366), Professional Practice (CH400), and Dynamic Modeling and Control (XE472).

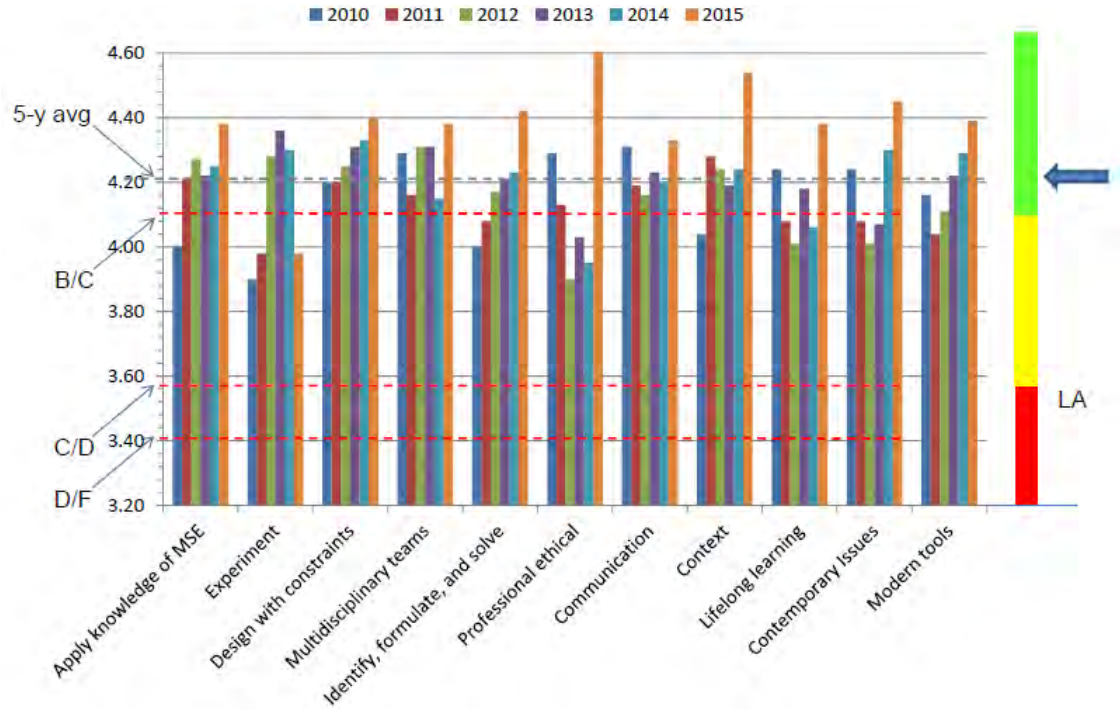


Course GPAs over a 5 year period, parsed from cadet transcripts, are presented in the graph below. Over the period, the highest grades were achieved in: Experimentation and Computing Tools, Transport Phenomena, and Material & Energy Balances. The lowest grades were in: Chemistry, Process Design, and Dynamics & Control.




## CADET ASSESSMENT OF ABET OUTCOMES

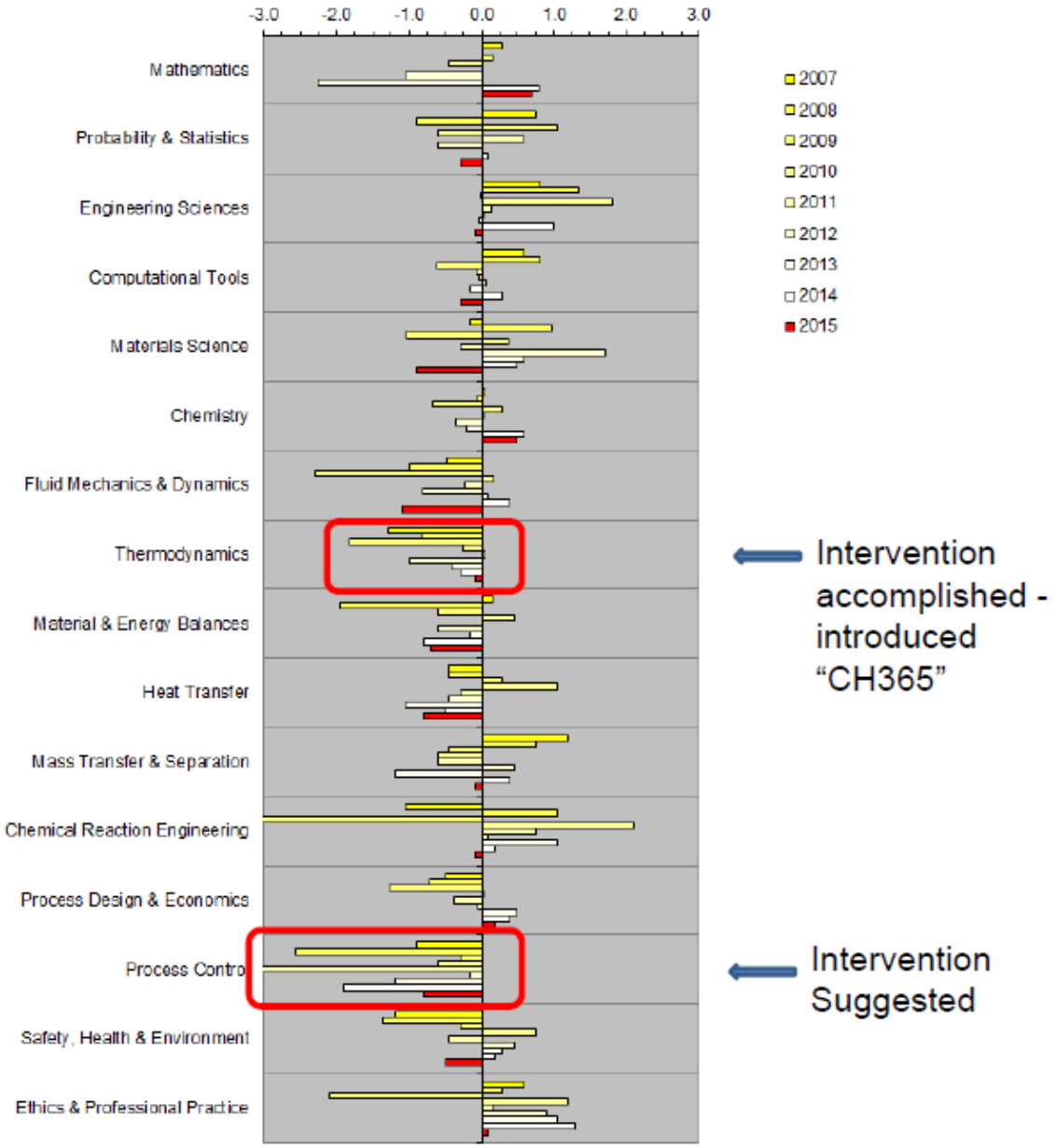
The 5-year summary of cadet assessments concerning their perception of whether the ABET objectives were satisfied is plotted in the graph below. None of the expected outcomes were felt to be unmet by the cadets. The ABET objectives that were scored the lowest by the students were: Professional ethics, and Experimentation capability.




## CADET PERFORMANCE ON THE 'FUNDAMENTALS OF ENGINEERING (FE) EXAM

The USMA ChE program encourages students to take the FE exam as the first step in professional licensing and registration, and also as a means for the faculty to compare cadet performance with others throughout the country who take the same exam at the same time.

The cadets who took the 2015 FE exam, in aggregate, had a passing rate of 77%, which was equivalent to that of all the people who took the exam in 2015. The normalized performance of USMA cadets versus others taking the exam is presented in the graph below. Areas in which USMA cadets excelled, compared to their peers, were: Engineering Sciences, Reaction Engineering, and Ethics and Professional Practice. Areas needing improvement include Thermodynamics, and Process Control.




## ADVISORY BOARD INTERACTION WITH CADETS

Advisory board members interacted with the entire 3rd and 4th year classes (cows and firsties) of cadets in a session segmented into 2 parts: 1) questions the advisory board addressed to the cadets, and 2) questions the cadets addressed to the advisory board. Advisory Board members then had lunch with ChE cadets at the West Point Club. Key questions addressed by the advisory board to the cadets are listed below. A summary of the discussions/responses between the advisory board and cadets is shown in Appendix 3.

- What are the most useful and least useful courses in the ChE curriculum (and why)?
- What is the availability of faculty and staff to assist students outside of the classroom?
- Are there adequate opportunities for cadets to interact with ChE students and programs at other colleges and universities?
- Do cadets observe a need for ChE capabilities in the Army?
- Do cadets believe that the Army values a ChE degree?
- How do cadets assess their career options after their mandatory service is completed (stay in or leave)?

Key questions addressed by cadets to the advisory board are listed below:

- How does the outside world view a USMA ChE degree holder?
- What are the trade-offs in pursuing an advanced degree in ChE versus pursuing an MBA?
- Is there a significant total compensation difference between ChE's in the Army versus private practice?
- Once commissioned, how long does it take for a graduate to be given the opportunity to practice ChE within the Army?
- What's the reward for pursuing as difficult and time consuming a program as ChE within the Army?

## ADVISORY BOARD FINDINGS

- The ChE program at USMA satisfies ABET requirements while meeting the mission and vision of both the Army and the Academy
- The ChE program is rigorous, quantitative, and built on a strong foundation of math and science
- ChE courses required at USMA cover the spectrum of topics relevant to ChE practice, both within the Army and in the private sector
- The engineering concentrations available cover most of the fields of study important to the field of chemical engineering
- The USMA cadets interviewed are the finest group of young people the Board members individually and collectively have been privileged to meet
- The Chemistry and Life Sciences department has been diligent in assessing conformance to objectives, and has a demonstrated track record in continuously improving the program
- The enrichment opportunities afforded by summer internships are outstanding

## CHALLENGES AND OPPORTUNITIES

Based upon the review of cadet performance using the metrics identified above, there are meaningful opportunities to improve the ChE program within the constraint realities of the Academy and the Army.

- The addition of the chemical engineering thermodynamics course should measurably improve cadet performance in the classroom and on the FE exam, but results should be monitored and examined thoroughly
- There are problems in the course content and applications in the process controls course. Cadets report a perception of the course being too theoretical, inadequate in practical applications, and focused on mechanical controls and robotics, rather than process industry controls
- Given that cadets have to select majors early (prior to spring break in 1st year), some form of introduction to chemical engineering should be considered to provide cadets with a more informed perspective of the major prior to major selection
- 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)
- The addition of the proposed biology course (CH275) should focus on what elements of biology are relevant to chemical engineering. Microbiology is important. Human biology, mammalian biology, anatomy, and other traditional medical based courses are less relevant
- Proposed CH401 (Introduction to Chemical Engineering Design Principles) should be coordinated with the existing design course (CH402)
- Proposed CH359 (Engineering Measurements) should balance the math with the physics of sensors, and how they are used in practice.
- The proposed bioengineering concentration is important, and should incorporate topics that other schools have determined to be important in their bioengineering concentrations that were established years ago.

## APPENDIX 1 – COMPOSITION OF ADVISORY COMMITTEE

| | | |
|---|---|---|
| **Kevin Shipe** ✓<br>Automation Innovation Engineer<br>NALCO Champion<br>7705 Hwy 90A, Sugarland, TX 77498<br>281-263-7335<br>kevin.a.shipe@gmail.com | **Lucy Hair** ✓<br>EleCent Team Leader<br>CPOIS Program<br>Lawrence Livermore National Lab<br>925-423-8545<br>hair1@llnl.gov | **COL (Ret) Paul Dietrich** ✓<br>3855 Victory Blvd<br>Staten Island, NY 10314-6716<br>718-698-8526<br>paul@the-dietrichs.com |
| **COL (Ret) Dwight Springer**✓<br>Former Deputy Head<br>Chemistry and Life Science<br>US Military Academy<br>817-431-5331<br>dss5456@verizon.net | **Anthony Pavone** ✓<br>Process Economics Program<br>HIS Chemicals<br>(650) 384-4311<br>tonypavone@ihs.com | **Brad Smythe**<br>Production Manager, Explosives Manufacturing, BAE Systems Inc., OSI<br>4509 West Stone Drive<br>Kingsport, TN 37660<br>((423) 578-6252<br>brad.smythe@baesystems.com |
| **CPT Joshua P. White** ✓<br>US Army Student Detachment<br>University of South Carolina<br>910-432-1859<br>joshua.p.white.mil@mail.mil | **Donald C. Glaser**✓<br>President, Simulation Solutions, Inc.<br>179 Avenue at the Common<br>Shrewsbury, NJ 07702<br>732-389-5400<br>dglaser@simulation-solutions.com | **Kisondra Waters** ✓<br>Principal Analyst, Competitive Cost & Margin Analytics, HIS Chemical<br>1 N Lexington Ave, 17th Floor, White Plains NY 10601, 650-714-1751<br>kisondra@gmail.com |
| **COL (Ret) Vance P. (Phil) Visser** ✓<br>2925 Thomas Smith Lane,<br>Williamsburg, VA 23185<br>philvisser@yahoo.com<br>757-254-3017 | **LTC Andrew Pfluger**✓<br>US Army Student Detachment<br>Colorado School of Mines<br>845-545-2235<br>andrew.r.pfluger.mil@mail.mil | **Matt Garvey**✓<br>Simulation Solutions, Inc.<br>Shrewsbury, NJ<br>mgarvey@simulation-solutions.com<br>3/31/20 |

## APPENDIX 2 – REQUIRED ChE PROGRAM COURSES

| Required Courses * | |
|---|---|
| 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 (replaced P. Chem Fall 2015) |
| CH383 | Organic Chemistry 1 |

## Appendix 3-Advisory Board Cadet Discussion Minutes

1. Which course is the least valuable/most poorly done?
    a. MC312. The focus is on engines and other Mechanical engineering centric principles and cadets don't see what value is added by taking the course.
    b. CH362. Covered a lot in all courses and is very simple. Collectively shot down by the advisory board.
    c. MC300. Cadets commented that it is simple statics that is covered in physics and isn't super valuable to them.
    d. Orgo 1. There is no building on the course so the cadets feel that it is a waste of time. Board commented a lot on the value of Orgo 2 from the sense of understanding the value of the first semester. They also asked about who would be interested in Orgo 2? Quite a few cadets were interested in taking the second semester.
2. What class needs improved.
    a. Controls. Cadets commented on their lack of chemical engineering control knowledge and are unable to apply anything they learn.
    b. 362-363 transition. Cadets don't feel ready for 363 after 362 because the level of difficulty increases significantly. A discussion ensued of placing 364 before 363. Cadets also complained that the textbook for 363 is hard to learn from.
3. Engineering sequence. Cadets felt that they wanted different courses to be available. No real comments on what they are looking for.
4. Bioengineering sequence. Lots of interest from cadets in the addition of this. Over half of cadets said that they would be interested in it if it was available.
5. How much writing is involved in the curriculum?
    a. Cadets felt that they write in most every engineering class.
    b. Orgo provides the most technical writing due to the number of lab reports they write.
    c. Advisory board discussed the potential addition of a technical writing course. Cadets thought it might help, but also Orgo 2 would provide extra technical writing opportunities.
6. Do you feel like you contribute to AIADs or are you just a place holder?
    a. Mixed results from cadets. Good and bad experiences.
    b. Advisory board asked if "homework" prior to AIADs would help cadets be in a position to make a larger impact during their short stay. Cadets thought that this would help them contribute more.
    c. Advisory board thought that contact between cadets and their sponsors starting during the spring semester would help cadets know more heading into their AIADs.

# Advisory Board Meeting Agenda

**8 April 2016**

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$$\frac{100\ \text{lbmol}}{.1} \times 352.92$$

Col Robert - intro

- explained changes in core curriculum and options given to cadets.
- explained changes to buildings - cadet barracks hundreds of millions committed over the next decade
- Course change in AY 15 to design of experiment
- Try to find problems from actual years

Back brief

- having cadets together (all together and longer) gave more information - several board members
- having seniors at the end of 4 years do better than first semester seniors.
- Training in effective brief powerpoint. - Tony cadets are good speakers - Lucy and Phil

Objective brief

- Kevin Shipe - objective 2 - transitioning operational environment
- Tony - we have to make decisions faster - accelerating velocity of life - still set to adapt to a quickly changing environment. What is relevant ~~to~~ yesterday is not relevant today.

Re-write of objectives 2 (2)

Contribute rapidly to the solution of infrastructure and operational problems in a dynamic and complex operational environment.
(Andy's write up of ab members comments)

Objective 3
Program graduates are lifelong learners capable of succeeding in graduate school or other advanced study programs.

Discussion of AAD's and relevance to Chemical Engineering

Discussion of ~~AAE~~ STAP

Curriculum

Biology or intro to Biology is wrong course for chemical engineers (Tony)

Tech writing course culminating in a course submission of a journal article for submission

" Visual Presentation of Quantitative Information "
by Tufte

Joshua White

Notes

1

# Chemical Engineering

## Advisory Board Meeting

8 April 2016

United States Military Academy
Department of Chemistry and Life Science

4/8/2016

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4/8/2016

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# Chemical Engineering

## Advisory Board Meeting

8 April 2016

**1. Introductory Remarks**

United States Military Academy
Department of Chemistry and Life Science

4/8/2016

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## Thank You! Advisory Board 2015-2016

| | | |
|---|---|---|
| **Kevin Shipe** ✓<br>Automation Innovation Engineer<br>NALCO Champion<br>7705 Hwy 90A, Sugarland, TX 77498<br>281-263-7335<br>kevin.a.shipe@gmail.com | **Lucy Hair** ✓<br>EleCent Team Leader<br>CPOIS Program<br>Lawrence Livermore National Lab<br>925-423-8545<br>hair1@llnl.gov | **COL (Ret) Paul Dietrich** ✓<br>3855 Victory Blvd<br>Staten Island, NY 10314-6716<br>718-698-8526<br>paul@the-dietrichs.com |
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4/8/2016

910-585 2385

## 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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## USMA MISSION

*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.

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# 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.**

***"Inspired to serve."***

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# 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.

4/8/2016

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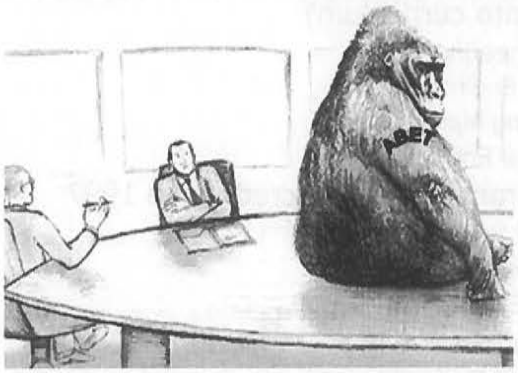
# PROGRAM MISSION

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.

4/8/2016

ABET Engineering Technology Accreditation Commission




Visit – 28-30 September 2014
Program Report Received – 30 September 2015
Accredited 1 October 2012 to present

FE: still registering in DE. Better tracking system

* keep up database of graduates and reach out for P.E. tracking. Etc.

Grand challenge course align w/ ABET credits

# Why ABET Accreditation?

- An external certification of quality
- Keeps us in touch with the engineering profession
- Helps USMA recruiting
- 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.

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# USMA ABET Accreditation

- Four programs initially accredited in 1985 (with introduction of majors into curriculum)
  - Civil Engineering
  - Electrical Engineering
  - Engineering Management
  - Mechanical Engineering
- Three programs initially accredited in 1997
  - Computer Science
  - Environmental Engineering
  - Systems Engineering
- Two programs initially accredited in 2008
  - Information Technology
  - Nuclear Engineering
- One program initially accredited in 2015
  - Chemical Engineering (retroactive to class of 2013)

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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

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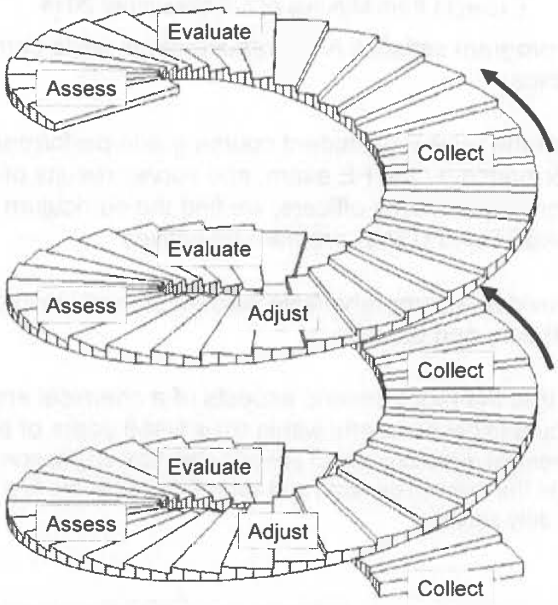
## Assessment Cycle




4/8/2016

Board recommendations: Where are they now?
- Feed back on how decisions are implemented



# 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

Adjusting courses to meet objectives instead of new courses. (Controls, e.g.)

Large discussion of theory vs practical. Adding a practicle engineer or graduation "so what"

# Advisory Board Findings

Excerpts from Minutes of 4-5 November 2014

• The USMA program satisfies Army requirements while complying with ABET guidelines.

• As a result of the review of student course grade performance, student performance on the FE exam, and survey results of graduating seniors and graduated Army officers, we find the curriculum amply satisfies the ABET and USMA program objectives.

• Program provides a comprehensive student immersion in chemical engineering theory and practice.

• Cadets felt that the more generic aspects of a chemical engineering education would likely be useful within their first 5 years of active duty
  - there remain questions about specific chemical engineering practice areas in the Army in general, and especially within the first 5 years of active duty service.

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## End of Section 1

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## Chemical Engineering

Advisory Board Meeting

8 April 2016

**2. Student Outcomes Assessment**

United States Military Academy
Department of Chemistry and Life Science

4/8/2016

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## 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. |

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## 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. |

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| Required Courses * | |
|---|---|
| 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 (replaced P. Chem Fall 2015) |
| CH383 | Organic Chemistry 1 |

*Not including prerequisites

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# Engineering Concentrations

Pre-approved elective sequences,
but ultimately cadet choice (can choose any 3) –
**to be updated with more options summer 2016**

**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

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# Assessment

CHEME Coursework Embedded Indicators

MECHE Coursework Embedded Indicators

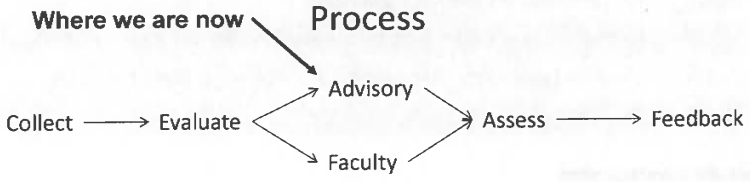
Fundamentals of Engineering Exam Topics

Participation in FE Exam (not pass rate)

Student end of semester surveys

Student CHEME Program Exit Surveys

Course Grades

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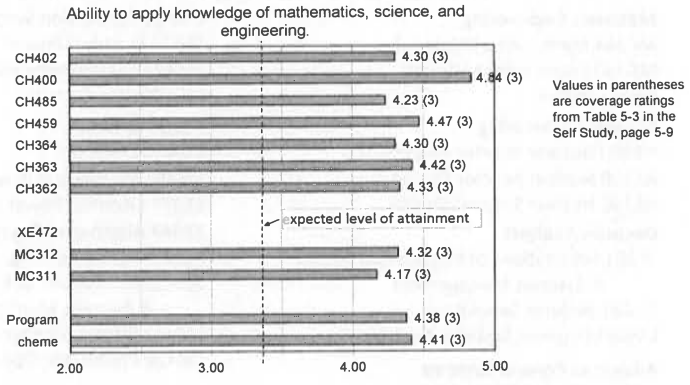
# Example Data: Coursework Embedded Indicators

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 2015

Similar data is collected for all 11 ABET outcomes

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Course change

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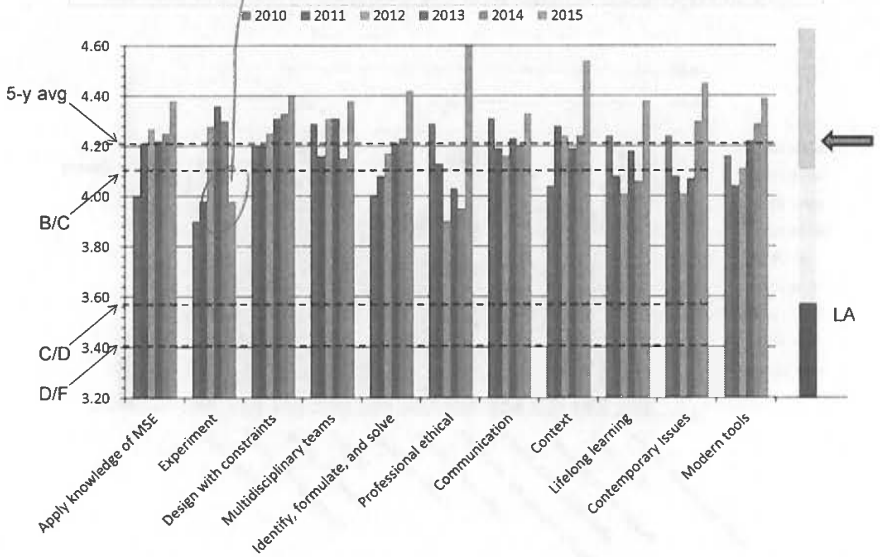
## Performance on Embedded Indicators

Program Averages AY2009 to AY2014

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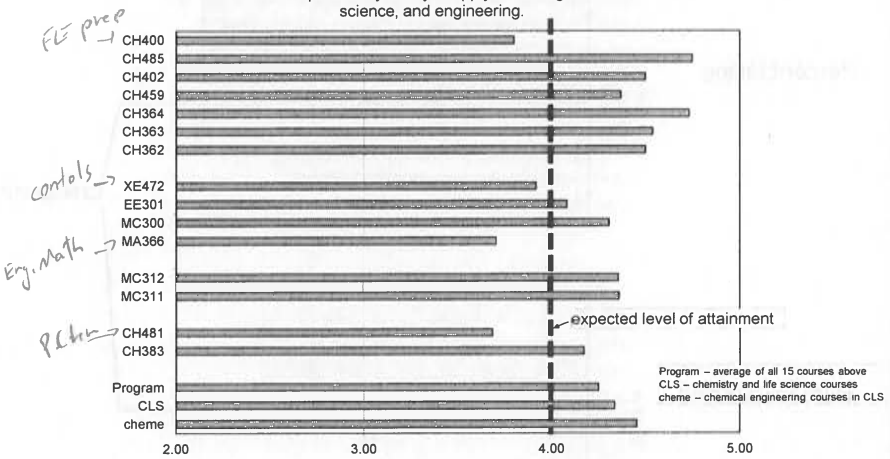
## Example Data: End-of-Semester Surveys

Student Outcome 1

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




Data shown here is for Class of 2015

Similar data is collected for all 11 ABET outcomes

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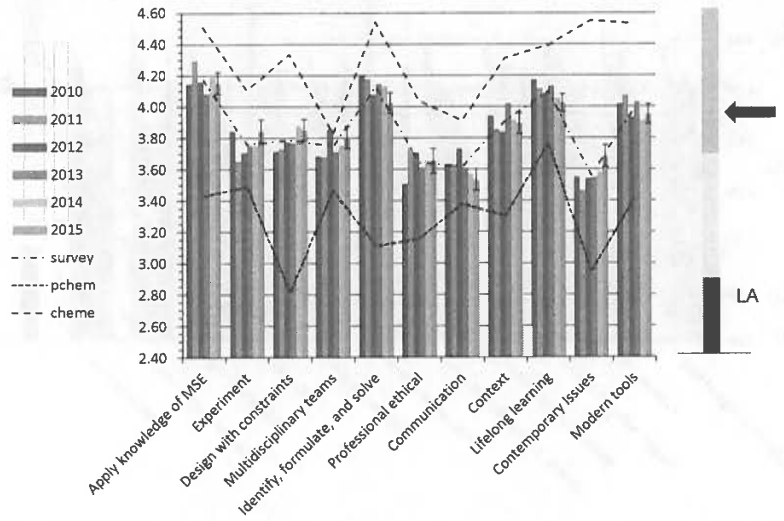
## End-of-Semester Surveys

Normalized Program Averages from AY10-15

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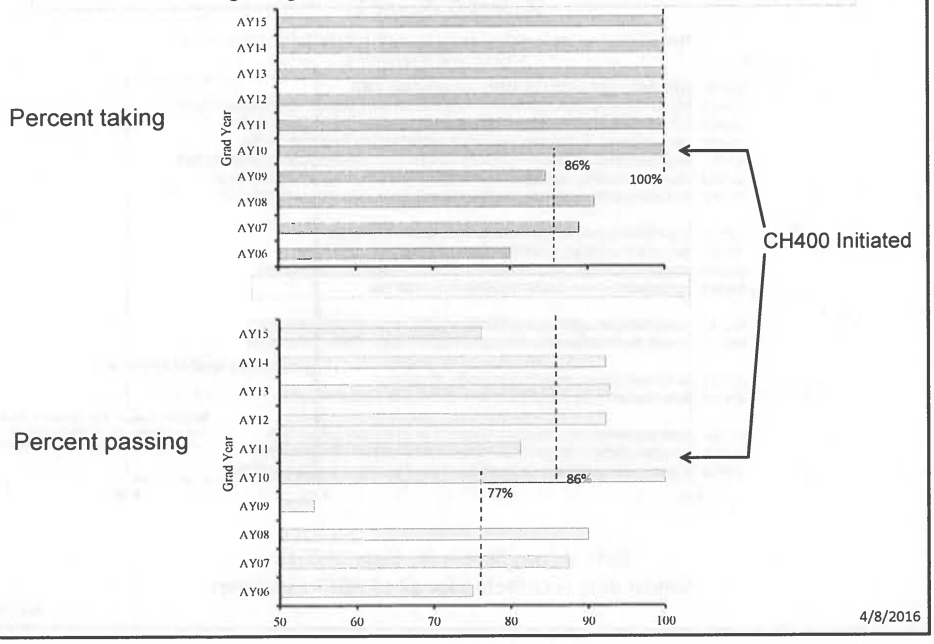
## Fundamentals of Engineering Exam

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

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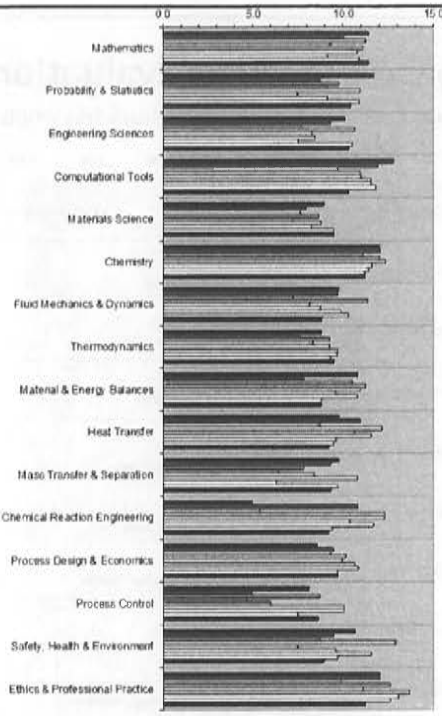
# Program Outcome Evaluation

Performance Indicators AY07 to AY15

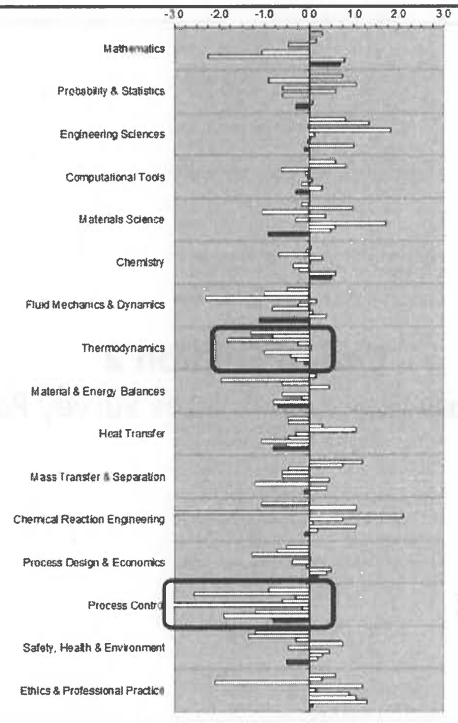
FEE Results




Trends need to be lifted out so data is normalized against national average

# Topical Outcomes Evaluation

Deviations from National Averages AY07 to AY15

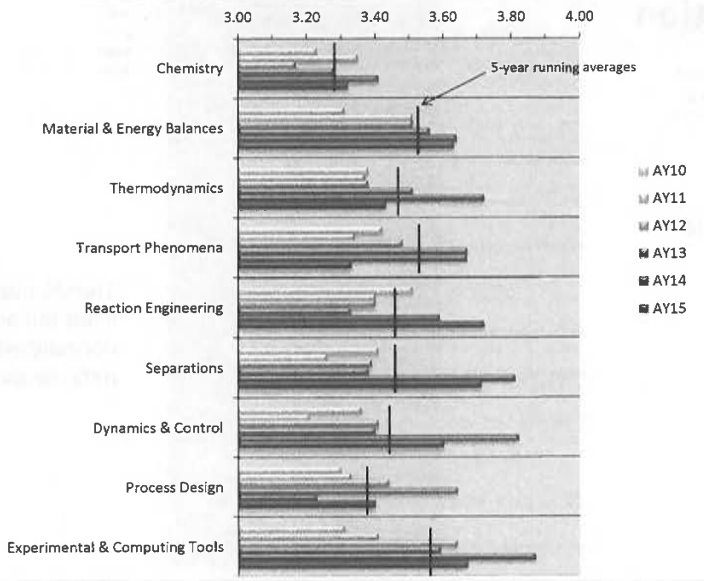



Intervention accomplished - introduced "CH365"

Intervention Suggested

## Topical Outcomes Evaluation

Average Course GPA After Parsing from Transcripts

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## End of Section 2

(Advisory Board Completes Survey Part 1)

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# Chemical Engineering

Advisory Board Meeting

8 April 2016

**3. Discussion of Program Objectives**

United States Military Academy
Department of Chemistry and Life Science

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## 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)

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## Program Objectives (Current Redbook)

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

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

USMA Redbook as of October 2010



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## Program Objectives

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.

and lifelong learners?

discussed adding in a flexible or adaptive component

Advisory Board Recommendation from October 2012

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## Assessment Instruments for Objectives

### Program Surveys

Program Advisory Board Surveys
Program Faculty Surveys
Program Cadet Surveys
Program Graduate Surveys (??)

### Strategy going forward:

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

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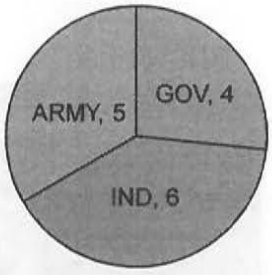
# Enrichment Opportunities

## Advanced Individual Academic Development (AIAD)

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




15 fully funded internships

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## End of Section 3

(Advisory Board Completes Survey Part 2)

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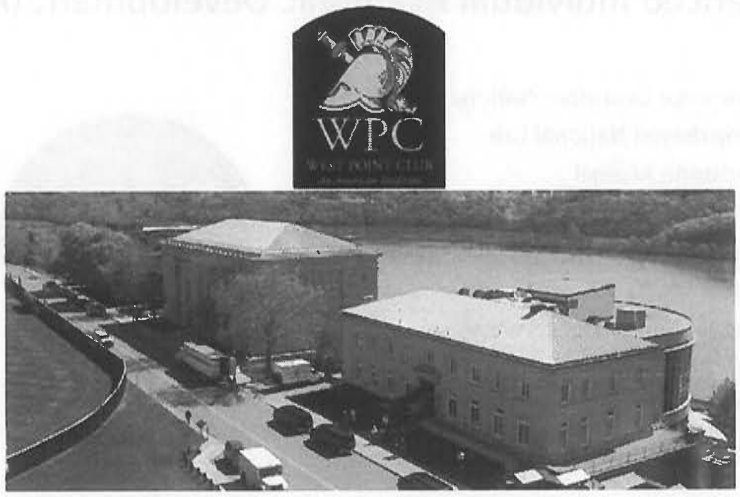
## Lunch – West Point Club



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

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# Chemical Engineering

Advisory Board Meeting

8 April 2016

**4. Future Challenges**

United States Military Academy
Department of Chemistry and Life Science

4/8/2016

## Academic Excellence

Academic Excellence

The Princeton Review

**#1 Most Accessible Professors**
**#6 Best College Library**
**#10 Best Athletic Facilities**
**#11 Best Classroom Experience**

Forbes.com

**#1 Public College in the country**
**#1 Best Buy**
**#2 Baccalaureate College**
**#11 Overall College in the country**

U.S.News & WORLD REPORT

**#2 Top Public Schools (Liberal Arts)**
**#3 Best Undergrad Engineering Program**
- **#2 Civil Engineering Program**
- **#4 Mechanical Engineering Program**
- **#6 Electrical Engineering Program**

**#22 National Liberal Arts College**

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# Strategic Influence

*Strategic Influences on Curriculum*

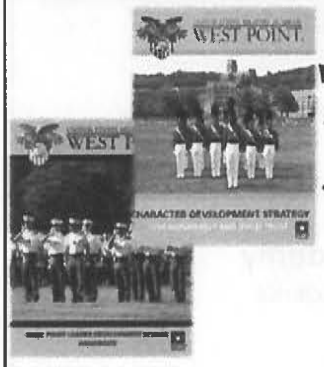
Governmental Strategic Guidance
- President
- Congress
- Department of Defense
- Government Agencies (e.g., NSA, FBI, CIA, …)

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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# Revised Curriculum

**CEN1 - Class of 2019**

| 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 | **MA366** 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 | **Engr Elective** 3.0 | **Engr Elective** 3.5 | *D* **LW403** 3.5 |
| **HI105** 3.0 | **HI108** 3.0 | *R* **SS201** 3.5 | *E* **DFL2** 4.0 | **MA206** 3.0 | **XE472** 3.0 | **SS307** 3.5 | *R* **HI302** 3.0 |
| | | | *R* **SS202** 3.5 | **PL300** 3.0 | | | **MX400** 3.0 |

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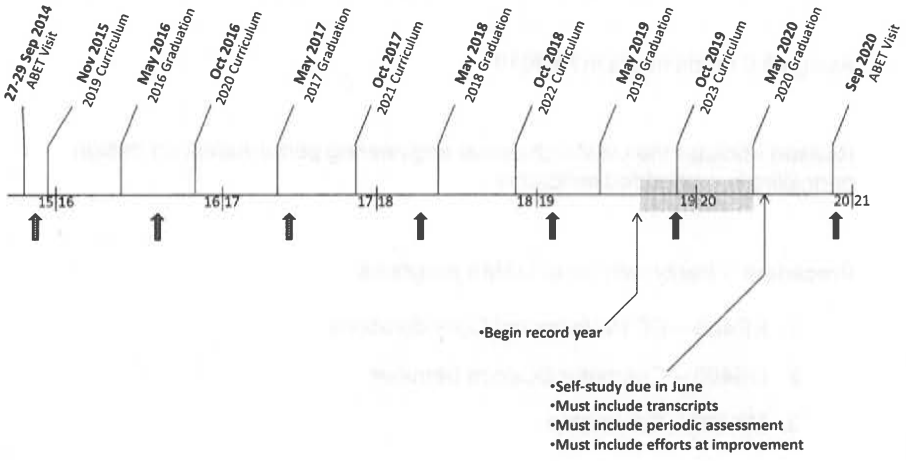
# Curriculum Changes and Impact

- Plebes choose majors prior to Spring Break
  - Additional administrative requirements
- 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

4/8/2016

Bio-engineering: This shall not pass

## Timeline for Curricular Actions




* Scrap reactor design and separations

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## Proposed Change 1

## CH366 Chemical Engineering Process Control

- Key potential shortcoming in response to assessment of chemical engineering control theory is apparent in the data.
- Demonstrated effort at continuous program improvement is critical to ABET accreditation (Criterion 4).
- Making this change is not a silver bullet (does not guarantee accreditation). But, it does demonstrate we are responding to the data.
- Loss of XE472 and interdisciplinary nature of program is a concern.

Intimately connected with assessment. Having collected data over a long period of time, response to data is critical. This rationale for creating and altering courses was pivotal in last ABET visit.

4/8/2016

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## Proposed Change 2

## Addition of CH401 Chemical Engineering Design Principles

Assign 3.0 credit hours in AY2019

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

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## Proposed Change 3

## 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

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.

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## Proposed Change 4

## CH359 Engineering Measurements

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

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# Proposed Bioengineering Sequence

- Proposed courses embedded within Life Science major
  - Meet engineering sequence requirement for life scientists
  - Electives for chemical engineers
  - Initial proposal (working DRAFTS)
    - Modeling and Analysis of Biological Systems
    - Forces, Fields, and Flows in Biological Systems
    - Biological Systems Design

4/8/2016

## Chemical Engineering Faculty

Can we support critical courses?

| | AY16 | AY17 | AY18 | AY19 | AY20 | AY21 |
|---|---|---|---|---|---|---|
| Biaglow | X | X | X | X | X | X |
| Lachance | X | a | a | ? | ? | ? |
| Winter | X | X | | | | |
| Belanger | X | | | | | |
| Bull | X | X | X | | | |
| Kalainoff | b | b | b | b | ? | ? |
| Armstrong | X | X | X | | | |
| White | | X | X | X | | |
| Onwuanumkpe | | X | X | X | | |
| Title 10 (Nagelli) | | X | X | X | X | X |
| James | | | X | ? | X | X |
| Miller, A. | | | X | X | X | |
| Pfluger | | | | X | X | X |
| Corrigan | | | | X | X | X |
| **Totals** | 7 | 9 | 10 | 7 | 6 | 5 |

a – available to teach; currently in registrar's office
b – available to teach; currently GenChem course supervisor

? – uncertain status